NORMAN A. JOHNSON
Editor

CHARLES A. WHITEHEAD
Managing Editor

MYRON D. REESER
Business Manager

HERBERT A. STAUDERMAN
Advertising Manager

WILLIAM J. O'CONNOR
Production Manager

BERYL A. LAKNER
Circulation Manager

OFFICIAL PUBLICATION OF THE PROCEEDINGS, AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

American Dyestuff Reporter was founded in 1917 and the Textile Colorist and Converter (formerly Textile Colorist) was incorporated with it in January, 1949. Published every other Monday, by the **HOWES PUBLISHING COMPANY, INC.**, 44 East 23rd Street, New York 10, N. Y. **C. R. Howes**, President; **Ernest J. Finan**, Executive Vice-President; **Norman A. Johnson**, Vice-President & Treasurer; **Myron D. Reeser**, Vice-President; **Clara Patrick**, Secretary.

Telephone SPring 7-9364

AMERICAN
# DYESTUFF REPORTER
DEVOTED TO TEXTILE WET-PROCESSING

## contents

VOLUME 48 APRIL 6, 1959 NUMBER 7

### special articles

Qualitative Chromatographic Method for Identifying Mildew Inhibitors on Military Fabrics ..... 31
Thomas E Miles and Armando C Delasanta
Textile Chemicals—Markets & Technology:—
Inorganics—Their Place and Expected Growth Pattern ..... 33
Ray L Currier
Organic Chemicals for Textile Finishing—Field with a Future ..... 37
William C Caldwell
Surfactants—Present & Future ..... 37
Carl A Bergman
The Textile Finishers' Challenge to the Chemical Industry ..... 44
Geo O Linberg
The Market Shop:—
Introducing a New Starch Size ..... 47
James P Casey
Development of Silicone Finishes in the Textile Industry ..... 47
W T Rossiter

### aatcc proceedings

***featured articles***

Dyeing of Acetate Blends and Arnel Triacetate Blends ..... 49
Victor S Salvin
Evaluation of the Celanese Wrinkle Tester .... 56
Ernest R Kaswell

***miscellaneous***

AATCC Calendar ..... 55
Activities of the Local Sections ..... 61
Employment Register ..... 61
Membership Applications ..... 61

### departments

News of the Trade ..... 63
General Calendar ..... 67
New Products and Developments ..... 68
Names in the News ..... 70
Abstracts ..... 72

Copyright, 1959, Howes Publishing Co, Inc
Contents of previous issues can be found by consulting the Industrial Arts Index and the Engineering Index, Inc, at your library

# TO SOLVE YOUR FINISHING PROBLEMS YOU NEED BOTH...

## TOP-QUALITY PRODUCTS

## TOP-QUALITY SERVICE

The *successful* solution of a finishing problem always calls for two things: 1) Expert technical analysis; and 2) Products which meet the specific need with scientific precision. You get both from the Textile Finishes Department of Procter & Gamble. P&G offers you unsurpassed experience in solving finishing problems that require fatty based finishes and softeners, and in developing and manufacturing the needed soaps and detergents.

If you are interested in eliminating finishing difficulties and improving your processing and results, be sure to have the Procter & Gamble Textile Finishes experts evaluate your situation—without cost or obligation on your part. The data you receive will be based on *your* fabrics, *your* finishing procedures . . . and whatever other special materials or conditions are involved in *your* problems. And this expert analysis will be backed up by a specialized product or products selected from the many developed in the famous P&G laboratories.

For all the facts call the P&G Textile Representative nearest you. Or, if you prefer, write to Textile Finishes Section, Procter & Gamble, Industrial Specialty Sales Department, Cincinnati 1, Ohio.

## New! PROXOFT-N

A remarkable new type of nonionic softener and lubricant. PROXOFT-N was developed by Procter & Gamble especially to give maximum stability with acids, salts and other trouble-making chemicals. It has the compatibility of the best nonionic agents and, at the same time, gives the desired lubricity and smooth, full-bodied softness which is characteristic of anionics. PROXOFT-N can be used advantageously on all types of natural and synthetic fibers.

PROCTER & GAMBLE

The **PROCTER & GAMBLE** Company • **TEXTILE FINISHES** Dept., Cincinnati 1, Ohio

**BRANCH OFFICES:** Atlanta · Baltimore · Boston · Brooklyn · Charlotte · Chicago · Cincinnati · Cleveland · Dallas · Detroit · Hartford · Kansas City · Los Angeles Louisville · Memphis · Milwaukee · Minneapolis · New Orleans · New York City · Omaha · Philadelphia · St. Louis · San Francisco · Summit (N. J.) · Syracuse

AMERICAN

DYESTUFF REPORTER

Volume 48 April 6, 1959 Number 7

# QUALITATIVE CHROMATOGRAPHIC METHOD FOR IDENTIFYING MILDEW INHIBITORS ON MILITARY FABRICS

THOMAS D MILES and ARMANDO C DELASANTA

*Textile, Clothing and Footwear Division*
*Quartermaster Research and Engineering Command, U S Army*
*Quartermaster Research and Engineering Center*
*Natick, Mass*

**At the present time there is no qualitative test for the identification of the various mildew inhibitors used on military fabrics. This paper presents a qualitative method using paper chromatography which can be used to identify copper-8-quinolinolate, salicylanilide,2,2'methylene - bis - (4-chlorophenol), and zinc salts of dithiocarbamic acid. The method is rapid and requires no specialized laboratory equipment.**

## INTRODUCTION

INTEREST has been revived in methods for identifying textile finishes. There are two reasons. One is the introduction of new analytical techniques, which are more rapid, more specific, and simpler than previous methods. The other is the introduction of many new textile finishes which do not fit into conventional finish identification schemes. A joint AATCC-ASTM Committee is currently working on a general method for finish identification.

This paper is concerned with the use of recently developed chromatographic techniques for the identification of mildew inhibitors commonly used on military textiles. An overall survey of the problem of microbial decomposition of cotton including the types of effective inhibitors and the basis for selecting those used on military fabrics has been published (*1*). Copper-8-quinolinolate, copper naphthenate, and 2,2′ methylene-bis-(4-chlorophenol) are the usual inhibitors. Other inhibitors find specialized military uses, for example, the zinc salts of dimethyldithiocarbamic acid and salicylanilide.

Typical requirements for nonflame-resistant fabrics containing inhibitors are listed in Military Specification MIL-D-504, "Dyeing and After Treating Processes for Cotton Duck and Twill". For flame-resistant fabrics containing inhibitors. MIL-D-10860, "Duck, Cotton, Fire-Water-Weather- and Mildew Resistant", is an example.

The military requirements usually allow a choice of inhibitors rather than specifying a single compound. The inhibitor may also be a combination of two compounds as in Military Specification MIL-D-10860, where combination of copper-8-quinolinolate and copper naphthenate are used. The inhibitor can also be part of a multipurpose finish, such as a flame-resistant, weather-resistant finish.

Since the amount of inhibitor is specified, requirements include quantitative chemical tests for the determination of mildew inhibitor content. Quantitative methods have been described in the literature for copper-8-quinolinolate (*2,3*). for phenolic inhibitors which include 2,2′ methylene-bis-(4-chlorophenol) (4,5), and for salicylanilide (*6,7*). Copper naphthenate and the zinc dimethyldithiocarbamate are determined by quantitative methods for zinc and copper. All quantitative tests require specialized laboratory equipment, such as electroanalyzers, spectrophotometers, etc. There is no simple spot-type test available for the qualitative identification of these inhibitors. Such a test would be useful.

Recent advances in chromatographic identification of chemicals make available test methods (*8*) which require little or no specialized equipment and are simple to use. Chromatographic methods have been developed for various types of textile finishes (*9, 10*). Essentially these identification methods are based on the fact that certain mixtures of solvents are capable of moving chemical compounds along paper at definable distances from the leading edge of the solvent. With the location of the solvent edge known, the location of the unknown chemical compound can be predicted. For example, in the test method described in this report, salicylanilide appears at .7 of the distance of the solvent front. The identification of the compound is further confirmed by identifying color reactions. Briefly, the method consists of placing a spot of the unknown on paper, dipping the end of the paper in a mixed solvent, and allowing it to wick along the paper. The paper is removed dried and washed with various chemicals which will produce certain colors for given compounds.

The method described identifies copper-8-quinolinolate and salicylanilide as such. It identifies copper naphthenate as a copper compound but does not distinguish it from other copper compounds (except copper-8). The zinc salts of dithiocarbamic acid are identified by the characteristic pink color of zinc with dithizone. 2,2′ methylene - bis - (4 - chlorophenol) is identified as a phenol by its color reaction with 4-amino-antipyrine but is not distinguished from other such compounds. Thus, the test identifies all of the inhibitors as the compound the quantitative specification test

identifies, with the exception of copper-8-quinolinolate and salicylanilide. For these two compounds the qualitative test identifies them as the specific compound.

These distinctions are sufficient to identify the type of mildew inhibitor present on military fabrics with the exception of coated fabrics. The method has been tried with FWWMR-treated duck containing combinations of copper-8 and copper naphthenate (MIL-D-10860), felt containing salicylanilide (MIL-M-2312), duck containing copper-8-quinolinolate and a water repellent (MIL-D-504), 2,2′ methylene-bis-(4-chlorophenol) and a water repellent (MIL-D-504), and zinc salts of dithiocarbamic acid and a water repellent (MIL-D-504). The method has limited application to coated fabrics. It can be used to identify copper-8-quinolinolate on such fabrics but the presence of inorganic zinc or copper compounds may interfere with the identification of copper naphthenate or the zinc salts.

## TEST PROCEDURE

The following test procedure is designed for the qualitative identification of copper-8-quinolinolate, copper naphthenate, 2.2′ methylene-bis-(4-chlorophenol), salicylanilide, and the zinc salts of dimethyldithiocarbamic acid. The method is designed for identifying these compounds on textiles when present in amounts specified for military fabrics.

*Chemicals*:

Butanol
Hydrochloric acid (6N)
Sodium hydroxide (2.5% by weight)
Dithizone (10 mg in 100 cc $CCl_4$)
Ethanol
4-Aminoantipyrine (2% by weight in a .025% by weight solution of sodium carbonate)
Potassium ferricyanide (8% aqueous solution)

*Apparatus*:

Petri dish (approx 6″ dia suitable)
Beaker (400-ml)
Filter paper (Whatman No. 3 for paper chromatography)
Medicine dropper or stirring rod or micro-pipette.

Take a sample of the fabric of approximately five grams. This does not have to be weighed but can be estimated from the type of fabric. For example, a piece 3½ inches x 3¼ inches of an FWWMR-treated 12.29-oz duck is approximately five grams.

The fabric sample is cut into approximately ¼-inch squares and placed in a beaker with about 200 ml of carbon tetrachloride and heated to boiling for 10 minutes. The volume is then reduced to about 100 ml.

Cut a circle of paper slightly larger in diameter than the Petri dish. From the edge to the center of the circle, cut a ¼-inch wide straight strip. This serves as a wick to carry the solvent.

Place a drop (if a glass stirring rod or medicine dropper is used) or 125 λ (if a micropipette is used) of the carbon tetrachloride solution at the center of the circle of filter paper. Air dry the paper.

Cover the bottom of one Petri dish with the appropriate solvent. (Solvent should not come into contact with paper except at the wick).

Two solvents (elutents) are used to move the mildew inhibitors along the paper. The first is a solution of 80%* butanol, 10% water, and 10% conc HCl (or 20% 6N HCl). This is used for the identification of all of the inhibitors except salicylanilide. The development procedures and location of inhibitors for this solvent are listed in Table I. The second solvent is a solution of 85% NaOH (2.5% by weight) and 15% ethanol. This solvent is used for salicylanilide. None of the other inhibitors are moved by this solvent except the zinc salts. Table I lists the development procedure and location of the inhibitors.

**TABLE I**
**Identification characteristics of mildew inhibitors**

| Inhibitor | Rf | Development Procedure | Color |
|---|---|---|---|
| **Elutent 80% butanol, 20% HCl (6N)** | | | |
| Copper naphthenate† | 0.3–0.4 | A | blue* |
| Copper hydroxynaphthenate | 0.3–0.4 | A | blue |
| Copper-8-quinolinolate | — | A | no color |
| Copper-8-quinolinolate | 0.7 | B | light green (fluorescent) |
| Zinc dimethyldithiocarbamate | — | A | no color |
| Zinc dimethyldithiocarbamate | — | B | no color |
| Zinc dimethyldithiocarbamate | 0.7 | C | pink |
| 2,2′-methylene-bis-(4-chlorophenol) | — | A | no color |
| 2,2′-methylene-bis-(4-chlorophenol) | — | B | no color |
| 2,2′-methylene-bis-(4-chlorophenol) | 1 | C | bluish green |
| 2,2′-methylene-bis-(4-chlorophenol) | 1 | D | bright red |
| **Elutent 85% NaOH (2.5%), 15% Ethanol (95%)** | | | |
| Salicylanilide | — | A | no color |
| Salicylanilide | 0.7 | B | fluorescent blue |
| Zinc dimethyldithiocarbamate | — | A | no color |
| Zinc dimethyldithiocarbamate | — | B | no color |
| Zinc dimethyldithiocarbamate | 0.6 | C | pink ring |

† Copper sulfate, copper chloride, and copper oleate had Rf values 0.3 — 0.4 and gave blue color.

* Unless otherwise noted, percentages refer to volume.

Place the circle of paper over the Petri dish allowing the wick to be immersed in the solvent. Cover with another Petri dish. Allow the solvent to cover at least two thirds of the area of the circle inside the dish. (Do not allow the solvent to reach the edge of the Petri dish.) Then remove the paper, mark the leading edge of the solvent with a pencil mark (for Rf determination) and allow the paper to dry.

The paper circle is then subjected to the following color development procedures, in the order given. Table I lists the color reactions and locations which identify the inhibitors. When a color ring develops, its location (Rf value) is obtained by measuring the distance from the origin of the spot to the ring and dividing by the distance from the spot origin to the solvent edge.

## COLOR DEVELOPMENT PROCEDURE

A) Place the paper over the ammonia fumes evolved from a concentrated solution of ammonium hydroxide.

B) Place the paper under a UV light to detect any color formation. (Cut the paper in half in the direction of the wick, using half for procedure C and the other half for procedure D.)

C) Wet the paper completely with a solution containing 10 mg of dithizone in 100 ml of $CCl_4$. Allow to air dry and note the color formation.

D) Wet the paper completely with a 2% solution of 4-aminoantipyrine in .025% sodium carbonate and immediately wet again with an 8% solution of potassium ferricyanide and note color formation after placing paper in ammonia fumes.

## REFERENCES


(1) Siu, R G H, "Microbial Decomposition of Cellulose with Special Reference to Cotton Textiles," Reinhold, NY (1951).
(2) Darbey, A, "Spectrophotometric Method for Routine Control Determinations of Copper-8-Hydroxyquinolinolate in Cotton Textiles," *Am Dyestuff Reptr* **42**, 453 (1953).
(3) Rose, A, Hutchinson, A Witt, Hayes, J R, and Sharkey, J R, "The Estimation of Copper-8-Quinolinolate in Mildewproofed Fabrics," *ibid* **45**, 362-4 (1956).
(4) Gottlieb, S and Marsh, P B, "Determination of Phenolic Fungicides," *Ind Eng Chem Anal Ed* **18**, 16-19 (1946).
(5) Hilton, C L, "The Identification and Estimation of Phenolic Fungicides in Mildewproof Materials," *Textile Research J* **28**, No. 3, 263-6 (1958).
(6) Matta, G, and Nunes, M L, *Anais Azevedos* (Lisbon) **3**, 21-36 (1951).
(7) *Ibid* **3**, 145-156 (1951).
(8) Block, R J, Durrum, E L, and Zweig, G, "A Manual of Paper Chromatography and Paper Electrophoresis," *Academic Press*, NYC (1955).
(9) Elod E, and Iorder, H, *Melliand Textilber* **34**, 860-3 (1953).
(10) Norwick, B, and Bierig, E, "A Chromatographic Method for the Identification of Amino Aldehyde Finishes on Textiles," *Am Dyestuff Reptr* **46**, No. 9, 314-5 (1957).

# TEXTILE CHEMICALS—MARKETS & TECHNOLOGY*
## A Symposium Conducted by the Chemical Market Research Association

PANEL

RAY L CURRIER
Columbia-Southern Chemical Corp
WILLIAM C CALDWELL
Wica Chemicals, Inc
CARL A BERGMAN
General Aniline & Film Corp
GEORGE O LINBERG
Melrose Chemical Corp
JAMES P CASEY
A E Staley Mfg Co
W T ROSSITER
Dow Corning Corp

## I. Inorganics—Their Place and Expected Growth Pattern

RAY L CURRIER
*Market Development Dept*
*Columbia-Southern Chemical Corp*

### INTRODUCTION

IN the Textile Dyeing and Finishing Industry, there are approximately 15 classes or groups of fibers which are being processed. Some of these fibers are processed as fibers, some are spun into yarn, and others are woven from yarn into fabrics. The actual processing of these textile materials has long been referred to as an art rather than a science. Therefore, there is no clear-cut flow sheet for any particular end product. It is not beyond the realm of possibility for two mills to be producing the same fabric in the same color and finish and yet not necessarily using the same chemicals or process.

To simplify this paper, I have broken the fiber field down into the following three classes: 1) cellulosics, 2) wool, and 3) synthetics (man-made). Included in the cellulosics class are cotton and viscose rayon; and under synthetics we find such fibers as cellulose acetate, nylon, Orlon, Dacron, Dynel, Zefran and many others.

### CELLULOSICS

First we shall consider the cotton and rayon. These fibers can be processed in three forms: 1) as raw stock. ie, the fiber as received in bales by the mills; 2) yarn, which is the raw fiber that has been manipulated on the proper machinery to put it in one continuous strand; and 3) fabric, which may be defined as woven or knitted goods made of yarn.

There are seven divisions of cotton or rayon processing. Prior to weaving yarn into a fabric, the warp yarn is usually sized with starch. This is to add strength and increase the yarn's ability to resist abrasion. Before any wet processing is begun, we go through the first operation shown in Table I, which is known as desizing or removal of size.

The second step, scouring or boiling off, would apply to all forms of cotton. This is performed primarily to remove impurities from the goods.

In the preceding step, the material is scoured, and oftentimes this is carried out in an alkaline solution. Therefore, to neutralize the material, the third step, which is an acid treatment called souring, is performed.

Number four, mercerizing, is the process by which cotton takes on the permanent silken luster when treated in an alkaline bath at ambient temperature.

Five, bleaching. Simply defined, bleaching is the removal of natural coloring matter from a fiber.

Six, dyeing and printing. This is the application of dyestuff or coloring matter to the textile fibers in their various forms.

Seven, finishing. Finishing may be best defined by using the dictionary term describing this art. It is said that finishing is the art and science of making material presentable to the consuming public.

Now that we have established the order in which cotton and other cellulose fibers may be processed, I would like to consider these steps one at a time and list the chemicals used in each step. (See Table I).

DESIZING——There are many mechanical methods employed to desize material, but basically, they all use the same chemicals. Probably the most widely used desizing agent today is the enzyme. The sizing material used most prominently in the textile field is starch. The enzyme reacts with starch to produce soluble sugars, which are subsequently washed out of the material. As you will note, I have listed sodium chloride here as it has been found by some mills that small additions of sodium chloride to the enzyme solution will speed up the reaction of the enzyme itself. I have also listed sulfuric acid and caustic soda. The purpose of either of these agents is to hydrolyze the starch into more soluble forms.

SCOURING (BOILING OUT)——In the next step, we show a list of five chemicals used for scouring or boiling out of material. To define boiling out, let's call it an alkaline treatment at high temperatures. These chemicals are not listed in the order of their importance. Rather than break these chemicals down and talk about them one at a time, I feel that we should group them all as scouring agents and as such, their function is to remove the impurities found in cellulose. These impurities take two forms. First, natural impurities which consist of natural oils and waxes. Second, the applied impurities, which take the form of oil, dirt, grease and graphite; these are accumulated by the goods while being processed in the mill. Oftentimes, only one of the chemicals shown here will be used, such as caustic or soda ash, but more than likely, one finds

* Held February 19, 1959 at the Dinkler Plaza Hotel, Atlanta, Ga.

several of these chemicals being used in combination. These chemicals, being alkaline in nature, will saponify the natural waxes, oils, and gums found in the fiber.

SOURING———Since the previous step is an alkaline treatment, the cotton material may contain some residual alkali. This residual alkali could cause the goods to have a high pH, depending upon the actual amount of alkali left in the material. As most materials are processed on the slightly alkaline side, it is desirable to adjust the pH of the cotton. For this purpose, two of the most common inorganic acids are used; namely, muriatic and sulfuric acids, and on the organic side, acetic acid, which is used in the case when only slight adjustments have to be made.

MERCERIZING ——— Here we show three chemicals that have major consumption: caustic soda and the two inorganic acids. In the mercerizing process, these two acids perform the same function as in the souring step. The application of strong caustic soda solution to cotton material causes a physical change rather than a chemical one. During the actual treatment of the cotton material, alkali cellulose is formed, but upon washing, the cellulose is regenerated, so, chemically, the end substance is the same as at the start and is changed in physical form only. Physically, the main change in mercerized cotton as compared to the unmercerized cotton, is the actual untwisting of the cellulose fiber. Also, some fiber swelling accompanies this untwisting.

BLEACHING———As all vegetable fibers contain natural coloring, which is often objectionable, this must be removed before further processing. Bleaching is an oxidation process for decreasing color. Shown here are many of the most commonly used bleaching agents: sodium hypochlorite, hydrogen peroxide, sodium peroxide, calcium hypochlorite and sodium chlorite. Also shown are sodium silicate, sodium phosphate, caustic soda, magnesium sulfate and borax; these are used as auxiliaries in the bleaching process. As you will note, many of the bleaching compounds contain chlorine. When these chlorine-containing bleaching agents are used, they must then be aftertreated with an antichlor. Sodium bisulfite is shown listed for this purpose. Hydrogen peroxide may also be used as an antichlor.

DYEING AND PRINTING ——— You will note here a marked increase in the number of chemicals employed. Various chemicals are used with the wide range of dyestuffs being employed. These dyestuffs are different in their chemical makeup and require different "assistants" to perform their operation.

To simplify, we have grouped the chemicals according to their use. Sodium chloride and Glauber's salt are considered exhausting agents. The term exhausting may be defined as the salting-out of dyestuff from the solution onto the material being dyed. Next we see aqua ammonia, sodium phosphates, sodium bicarbonate, sulfuric and muriatic acid, and potassium carbonate. As the dyebath or printing paste must first be set at a given pH, these chemicals are employed as pH adjustors. As well as adjusting the pH, soda ash, sodium bicarbonate, sodium phosphates, potassium carbonate may also be employed in the dye solution as scouring agents.

After they are applied, certain dyestuffs require aftertreatments to increase fastness to light. Copper sulfate is commonly used and potassium chromate may be employed when an increased fastness to washing is desirable.

Another group of chemicals used in the dyebath are the potassium and sodium bichromates. They are referred to as mordants. A mordant is usually a metallic salt which will couple with the goods being dyed. The dyestuff then couples to the mordant to form a fixed color on the fiber. Vat-type dyestuffs, which possess very excellent fastness properties to washing and light, are often purchased in the insoluble form. Before these dyestuffs can be applied to cotton or the cellulose-type fibers, they must first be reduced. This is accomplished through the use of sodium hydrosulfite and caustic soda. Once they have been reduced, they may be applied to the material. After they have penetrated, they must be oxidized to produce the final form of the vat dye. This oxidation is accomplished by passing the goods through a weak solution of hydrogen peroxide or sodium perborate.

There is also another class of dyes known as the sulfur dyes, which are insoluble, and their reduction is performed by sodium sulfide and soda ash. Still another type of dyeing is the diazotizing and developing of direct dyestuffs. In this method of dyeing, direct color is applied to the goods, which are then washed and treated with sodium nitrite and sulfuric acid. After this step is accomplished, a developer is added, which

**TABLE I**

**Inorganic chemicals used in cotton and rayon processing**

1) **DESIZING**
- sodium chloride
- sulfuric acid
- caustic soda

2) **SCOURING OR BOILING OUT**
- caustic soda
- soda ash
- sodium bicarbonate
- sodium phosphates
- sodium silicate

3) **SOURING**
- muriatic acid
- sulfuric acid

4) **MERCERIZING**
- muriatic acid
- sulfuric acid
- caustic soda

5) **BLEACHING**
- A) *Bleaching Compounds*
  - sodium hypochlorite
  - hydrogen peroxide
  - sodium peroxide
  - calcium hypochlorite
  - sodium chlorite
- B) *Auxiliaries*
  - sodium silicate
  - sodium phosphates
  - caustic soda
  - sodium sulfate
  - borax
- C) *Antichlor*
  - sodium bisulfite
  - hydrogen peroxide

6) **DYEING AND PRINTING**
- A) *Exhausting Agents*
  - sodium chloride
  - Glauber's salt
- B) *Aftertreatment*
  - copper sulfate (lightfastness)
  - potassium chromate (washfastness)
- C) *Scouring and/or pH Adjustment*
  - aqua ammonia
  - sodium phosphates
  - sodium bicarbonate
  - sulfuric acid
  - muriatic acid
  - potassium carbonate
  - soda ash
- D) *Mordant*
  - sodium bichromate
  - potassium bichromate
- E) *Dyestuff Reduction*
  - sodium hydrosulfite
  - caustic soda
  - sodium sulfide
  - soda ash
- F) *Diazotizing and Developing—Direct Dyestuffs*
  - sodium nitrite
  - sulfuric acid
  - muriatic acid
  - caustic soda
- G) *Dyestuff Oxidation*
  - hydrogen peroxide
  - sodium perborate
  - sodium chlorate
- H) *Dyestripping*
  - zinc hydrosulfite

7) **FINISHING**
- A) *pH Adjustment*
  - soda ash
  - aqua ammonia
  - sodium bicarbonate
- B) *Resin Treatment Catalysts*
  - zinc nitrate
  - ammonium sulfate
  - ammonium chloride
  - magnesium chloride
  - diammonium phosphate
- C) *Fire Retardants*
  - borax
  - boric acid
  - ammonium sulfamate
  - antimony oxide
  - calcium carbonate

## TABLE II

### Inorganic chemicals used in wool processing

1) PULLING
- sodium sulfide
- lime
- soda ash

2) SCOURING
- soda ash
- caustic soda
- sodium bicarbonate
- sodium phosphates

3) CARBONIZING
- sulfuric acid
- soda ash

4) BLEACHING
- hydrogen peroxide
- sodium silicate
- aqua ammonia
- sulfuric acid

5 & 6) DYEING AND FINISHING

A) *Exhausting Agents*
- Glauber's salt
- sulfuric acid
- ammonium sulfate
- diammonium phosphate
- sodium bisulfate
- acetic acid

B) *Mordant*
- sodium bichromate

C) *Auxiliaries*
- aqua ammonia

D) *Finishing*
- chlorine

is an organic compound, to produce the desired effect. Direct colors treated with a developer show improved fastness properties. Hydrochloric acid may sometimes be substituted for sulfuric acid in this operation. Many of the developers used require an alkali to solubilize them; and in most cases, caustic soda and soda ash may be used for this purpose.

Textile Mills do not like to talk about their bad work, but occasionally a dyer will find it necessary to remove dye from the goods in process. The taking off of a color is called stripping. The stripping of color is necessitated by such defects as uneven or shaded dyeings, streaks, blotches, and stains. While most stripping agents are purchased in the form of prepared compounds, one of the basic ingredients in most of these compounds is zinc hydrosulfite.

FINISHING——Here again, we notice a large number of chemicals being employed. While most of the finishing agents are organic in nature, many times they require inorganic additives for pH adjustment. Among these, we might find soda ash, aqua ammonia, sodium bicarbonate and others. In today's resin-treating field, there is wide demand for catalyst. In this category, we have zinc nitrate, ammonium sulfate, ammonium chloride, magnesium chloride and diammonium phosphate.

Also shown are a group of chemicals under the heading of fire retardants. Borax and boric acid, when combined in the proper ratio and applied to material to be treated, yield a flame-resistant finish. Material may also be treated in a 15 percent solution of ammonium sulfamate, thus acquiring a flame-resistant finish. Antimony oxide and calcium carbonate are used as additives to a chlorinated paraffin solution. This solution, when bound to material by an organic resin, yields a suitable flameproofing for heavy duck or canvas.

Recent reports show that a few finishers are using hydrogen peroxide as an aftertreatment for resin-treated goods to eliminate odors. This is an important consideration since odor is among one of the most objectionable characteristics found in resin-treated materials.

## WOOL

Next we shall consider wool, a natural protein fiber. In my opening remarks, I mentioned the complexity of textile processing; this was intended to cover all fibers and, therefore, wool is included. Now, let us examine Table II. You will note that the number of mill processing steps have been cut down to five; I show six. The first step is pulled wool; this operation is not performed in the mill itself but by various wool pulling organizations throughout the country. This is mentioned since this process does consume certain inorganic chemicals in removing the wool from the pelts after the sheep have been slaughtered.

The second step is scouring. This step is the first processing by the mill. Scouring is performed to remove the impurities in wool. These impurities fall into three classes: natural, acquired and applied. Natural impurities are oil, fats, salts; acquired impurities are sand, dirt, pollen and other vegetable matter; and applied impurities are tar, pitch and other chemicals used for treatment of disease or for identification purposes.

The next step is carbonizing. All wool contains a large or small amount of vegetable matter. This appears in the form of burrs, seeds, twigs, leaves or straw picked up by the sheep in grazing and must be removed before further processing. Carbonizing may be defined as a chemical removal of vegetable matter.

Wool contains a natural coloring matter. This is removed in the bleaching operation.

In wool finishing, we may use the same definition as applied to cotton; that is, the art and science of making materials presentable to the consuming public.

Now in breaking down our sequence of operation, let us first consider wool pulling.

PULLING——Sodium sulfide, lime, and soda ash are the principal chemicals used in the wool pulling operation. After the hide is removed from the sheep, it is then washed in a solution of soda ash. There are actually two processes employed by which the wool is removed from the hide. The first process uses a solution of slacked lime, which is painted on the skin side of the hide. The hides are then stored overnight and the next morning the wool may be easily removed. In the second method, a solution of sodium sulfide and lime are painted on the skin side and this solution remains approximately 24 hours before the wool can be removed.

SCOURING——Next we show the scouring step, which uses soda ash, caustic soda, sodium bicarbonate, sodium phosphates, all of which are alkalis. Through the use of these alkalis, we obtain the emulsification and partial saponification of fats, grease, oils, and the suspension of dirt particles. The treating of wool in an alkaline solution is commonly referred to as soap alkali process. Of equal importance when talking about scouring wool in our present day is the use of detergents. When these detergents are used as the scouring solution, the pH is usually neutral and, therefore, a gentle scour is performed. Detergents find wide use in scouring wools which have a low grease and oil content. Solvents such as perchlor- and trichlorethylene may be used for degreasing or scouring wool but, because of their cost, have found little application to date.

CARBONIZING——The sulfuric acid process is by far the most widely used process for carbonizing wool. This process is performed in four parts. The wool is treated in a 4%-6% solution of sulfuric acid at room temperature, then heated and dried with the acid remaining in the wool. The strong concentration of acid chars the vegetable matter. In subsequent operation, this vegetable matter is crushed and is then brushed or beaten until it is removed from the wool. For neutralizing the wool, soda ash is commonly used.

## TABLE III

### Inorganic chemicals used in the processing of synthetics

1) SCOURING
   - soda ash
   - Glauber's salt
   - sodium phosphates

2) BLEACHING
   - sodium chlorite

3) DYEING AND PRINTING
   - A) *Exhausting Agents*
     - sodium chloride
     - Glauber's salt
   - B) *After treatment*
     - copper sulfate (lightfastness)
     - potassium chromate (washfastness)
   - C) *Scouring and/or pH Adjustment*
     - aqua ammonia
     - sodium phosphates
     - sodium bicarbonate
     - sulfuric acid
     - muriatic acid
     - potassium carbonate
     - soda ash
   - D) *Mordant*
     - sodium bichromate
     - potassium bichromate
   - E) *Dyestuff Reduction*
     - sodium hydrosulfite
     - caustic soda
     - sodium sulfide
     - soda ash
   - F) *Diazotizing and Developing—Direct Dyestuffs*
     - sodium nitrite
     - sulfuric acid
     - muriatic acid
     - caustic soda
     - soda ash
   - G) *Dyestuff Oxidation*
     - hydrogen peroxide
     - sodium perborate
     - sodium chlorate
   - H) *Dyestripping*
     - zinc hydrosulfite

4) FINISHING
   - caustic soda
   - sodium bicarbonate
   - antimony oxide

BLEACHING ——— Wool is bleached with hydrogen peroxide. Sodium silicate may be used in this process as a stabilizer or buffer. Aqua ammonia can be used for pH adjusting. In a number of cases, raw stock wool will be bleached in a bleaching solution containing hydrogen peroxide plus sulfuric acid or formic acid.

DYEING AND FINISHING——— Chemicals that we term exhausting agents for wool dyestuffs are: Glauber's salt, sulfuric acid, ammonium sulfate, diammonium phosphate, sodium bisulfate, and acetic acid. Sodium bichromate shown here is used as a mordant and finds wide use when chrome-type dyestuffs are applied. Chrome dyestuffs contain a metal complex and the mordant works in the same manner as it did for the cotton material. The use of aqua ammonia in wool dyeing is primarily for pH adjustment although it is often used for light stripping action or color removal from dyed material.

One of the chief chemicals used in wool finishing is chlorine. Chlorine is used for shrinkproofing of wool fabrics. This type of finishing is by no means the only finishing operation performed on wool, but is the only one that employs the use of an inorganic chemical in sizable amounts. Other wool-finishing techniques are mothproofing, crease resistance, and others designed to give a desired effect. These are usually performed by materials that are purchased from specialty manufacturers and are sold under tradenames.

## MAN-MADE FIBERS

With the aid of Table III, let us consider the man-made fibers. These materials differ from our natural fibers in that they do not contain the natural impurities that are found in wool and cellulose-type goods. Therefore, the actual operations such as scouring, souring and bleaching, preparatory to dyeing and finishing, are somewhat simplified.

Once again, we show scouring, which is a cleansing or purification step and is performed to remove acquired oils or dirt that have been received in the manufacturing operation. Bleaching is rarely necessary since the fibers or yarn are already bleached in the original manufacturing. Although in some cases, when a higher degree of whiteness is desired, the material will be subjected to a bleaching operation, this is the exception rather than the rule.

After the synthetic material is scoured, dyeing and printing is the next operation. The term finishing here has the same meaning as applied to cotton and wool fabrics.

SCOURING———Scouring of synthetic fibers, in most cases, is rather a simple operation as these fibers are in good condition when received by the mill. This operation is accomplished with alkalis and phosphates. The scouring operation is performed at rather low temperatures.

BLEACHING———Under bleaching chemicals we find sodium chlorite. This chemical is used by some mills to increase the whiteness of the synthetic goods. Some of the mills are now using a fluorescent brightening agent to obtain a full white on synthetic material.

DYEING AND PRINTING——— To minimize on repetition, I believe that it would be safe to say that the same inorganic chemicals used in dyeing cotton and wool are used for dyeing synthetics. These chemicals perform primarily the same functions.

## TABLE IV

### Estimated consumption of inorganic chemicals by the textile processing industry 1958

| | *Short Tons* |
|---|---|
| Caustic soda | 225,000 |
| Chlorine | 30,000 |
| Hydrogen peroxide (anhydrous) | 12,000 |
| Muriatic acid (20° Be) | 4,000 |
| Soda ash | 75,000 |
| Sodium bicarbonate | 5,000 |
| Sodium bichromate | 4,000 |
| Sodium chlorate | 1,000 |
| Sodium chloride | 225,000 |
| Sodium perborate | 500–1,000 |
| Sodium silicate (anhydrous) | 5,000 |
| Sodium sulfate | 45,000 |
| Sulfuric acid (100%) | 30,000 |
| Zinc oxide | 3,000 |

FINISHING———Synthetics lend themselves very well to mechanical finishing, therefore, the inorganic chemicals required in the finishing operation are few in number. Among the inorganic chemicals used, we might find caustic soda and sodium bicarbonate used for the stabilization of certain fabrics. By stabilization, I refer to the dimensional stability of fabrics. Antimony oxide may be used in fire-resistant formulations.

## BLENDS

Still another variable, in textile dyeing and finishing, is the processing of blends. At the beginning of this talk, I stated that there are approximately 15 major fibers being processed in the textile field. The more common blends appear in two and three fiber combinations. Menswear fabrics are a good example of blends. The more popular menswear blends are 75% synthetics, 25% cotton; 60% wool, 40% synthetic; and 50% rayon or cotton and 50% acetate.

## CONCLUSION

The textile industry presents many problems to one attempting to survey its requirements for the various chemicals used. First, the buying habits of the industry are diverse and one encounters such features as cooperative buying and buying through agents or brokers as standard practice for some segments of the textile field. Second, jobbers play a very important part in the purchases of textile concerns. We believe that most published end-use patterns showing textiles as a consuming segment reflect in large measure only the direct movement of products from basic manufacturers to the textile industry and largely overlook the very extensive movement handled by jobbers. Third, textile processing remains an art rather than an

exact science and this causes an extrapolation based upon yardage or weight of goods processed subject to considerable error. Fourth, there are no trade associations in the textile industry who keep adequate statistics concerning the requirement for processing chemicals by the textile industry. Fifth, many of the commodities used by the textile industry are in the form of proprietary or trademarked materials which are produced and sold by a multitude of specialty chemical houses. Sixth, the textile industry suffers from a considerable fluctuation in rate of activity from year to year.

Table IV shows our estimate of the requirements for some of the major inorganic chemicals used by the textile industry.

These figures are based upon trade contacts and discussions with government bureaus, particularly BDSA, and they have been cross-checked with several trade organizations and other people familiar with the textile field. We offer them, not as exact figures, since by the very nature of the industry it is impossible to define requirements precisely, but as indications of the quantities of materials consumed in this important industry.

# II. Organic Chemicals for Textile Finishing—Field with a Future

**WILLIAM C CALDWELL**
***President, Wica Chemicals, Inc***
***Charlotte, NC***

## INTRODUCTION

WHEN I was invited to initiate a talk concerned with market research, I had several reasons for being a bit apprehensive, and the primary thought hinged around my disseminating information of the market type to you who are primarily occupied with chemical market research. As a manufacturer of organic chemicals designed for textile finishing, this short experience with market research has given me a greater respect for the basic issues of chemical market research.

Most textile chemical manufacturers—and particularly we who process textile chemical specialties, either in whole or in part of our production—are occupied primarily with the needs of the industry rather than in the promotion of materials that might be running out of our ears as a result of vertical economies. The exceptions are notable in some of my personal experiences involving the exploitation of polyvinyl acetate emulsions, for which our company has developed facilities to produce more than ten million dry pounds annually. Needless to say, we are pushing PVAc. It is noteworthy that the processing equipment employed by our people (and I assume this to be the case with most small manufacturers of chemicals) is not special purpose to any great extent and will lend itself to the processing of most types of organic finishing agents used in the textile industry.

Such flexibilities preclude any estimations based on manufacturing capacities or potentials as far as extensions at the small-plant level are concerned. Too, let us consider the innumerable modifications of the textile specialty materials; those products that are further processed or compounded for some specific, and many times urgent, requirements. As an example, rubber latex may be reprocessed to include several parts of clay or carbonate filler for each part of rubber solids in the ready-to-use compounds. Frequently, basic materials, such as styrene butadiene latex, polyoxyethylenes, polyethylenes, quaternaries, etc, lose their identities through compounding and through tradename disguises. Difficulties in establishing use patterns for these materials are furthered by multiple applications of finishing chemicals in operations throughout the basic mechanical phase of fabric manufacture. In other words, a chemical used in finishing might also be applied to fibers even prior to spinning, or/and during several operations before the final finishing touch.

Much has been said about starch substitutes and many efforts are being made to cut into this two-hundred-million-pound field with various water-soluble film formers. I recall an instance in Mexico, a few years ago, when I visited one of the finishing houses for the purpose of demonstrating some rubber latex finishes with backcoating techniques. The trough that held the latex and the pick-up roller were necessarily fabricated from wood—as this was the only material we could find around the plant area. To add to my misfortunes, the trial lot of latex was held up somewhere enroute, and time did not permit waiting, so I prepared a starch mix that would approximate most of the wet properties of the latex compound and the special fabric was hauled out for the trials to train the operators by simulated methods. Yes, they liked the starch and probably use it yet.

The textile finisher is concerned with modifying his goods to add stiffness, softness, durability, and weight. He is concerned with shrink-resisting, crease-resisting, flame-proofing, and water-, oil- and soil-resisting properties. He is concerned with finishes that resist bacteria, moths, and even static electricity. The finisher proceeds to render the fabric acceptable to the ultimate consumer.

A portion of the finishing operations depends entirely on the physical properties of the fibers and of the fabric construction. These mechanical aspects may be applied in conjunction with coating or impregnating applications of chemical finishing agents that adhere to the fibers to achieve special results. The finishing operation might involve a chemical process to modify the fibers.

There are many considerations the textile chemist must make regarding the proper selection and use of the chemical tools he has available. The industry recognizes a series of standard test methods developed by the American Association of Textile Chemists and Colorists. In some instances, the overwhelming desire to attain specific properties of a fabric will possibly be cause for a compromise of other specifications. The finisher is very much aware of the effects his chemicals and processing conditions will have on the finished fabrics, especially in anticipating that the goods might be submitted to the following tests:

a) Hand
b) Shrinkage control
c) Crease resistance
d) Durability of finish to multiple washes
e) Effect on dyed shades
f) Lightfastness
g) Tear strength
h) Tensile strength
i) Abrasion resistance
j) Seam slippage resistance
k) Sewability
l) Needle cutting
m) Chlorine resistance.

High cost factors, compatibility problems, handling and processing hazards, discomforts, skin rash effects, and inadequate processing facilities, in addition to failure to pass the above tests, may restrict the use of an otherwise good finishing chemical.

Possibly, formaldehyde is one of the most classic examples of such an "otherwise good finishing chemical." As far back as just after the turn of the century, this use chemical was known to permanently modify certain properties of cellulosic materials. It has never been accepted to any great degree because of several obvious reasons. These are:

a) Objectionable and irritating odor in plant use.
b) Toxicity of high concentrations in air.
c) Variations of results obtained.
d) Excessive embrittlement of fiber.

Later, the Germans founded some vast improvements with formaldehyde treatments of cellulose by mixing with urea or guanidine. Then the English made some simple condensates of urea and formaldehyde. The Tootal Broadhurst Co pioneered the use of water-soluble UF resins for stabilizing, creaseproofing and stiffening cotton, linen and rayon fabrics.

The introduction of these resins in the United States was made early enough to be recognized as "flourishing" during the mid '30s when our rayon industry was well into its own. The two types of resins originally introduced to this country included a monomeric type (low formaldehyde and urea ratio) and a polymeric type, which is also water-soluble but has been deliberately reacted to a polymeric state. The monomeric types penetrate. or are diffusible in the fibers. They are very inefficient on a solids basis compared with straight formaldehyde and are usually applied to rayon fabrics to deposit from 12-20% fixed resins. The polymeric types produce hand and increase bulk and stiffness of rayon fabrics. Some use in stiffening nylon is noted.

It is significant that these two simple methylol ureas, as originally introduced to this country, still account for almost a third (by weight) of the entire 60 million plus (dry) pounds of thermosetting resins in US textile finishing. The monomeric type, supplied as a 50-55% paste or cream, has sold for as little as 7¢ per wet pound, delivered to the mills in TL, drums, and its price history shows the resin has sold for as much as 16¢ per wet pound during its good years. The syrupy polymeric type has ranged in prices from 12½¢ to 30¢ per liquid pound as 30-70% solids.

The methylol ureas looked good and were widely accepted in rayon finishing. The problems invariably encountered with straight formaldehyde were mostly overcome. However, the finisher found himself living with some problems of poor resistance to multiple washings, progressive shrinkage, poor product storage stability, lack of durability in glaze finishing of cottons, and high retention of chlorine in bleaching operations. As always, the industry was in need of improved finishing materials and much research work was done in effort to overcome these inherent disadvantages of UF. The melamine-formaldehyde resins were the first new major class of resins to be developed and exploited to supplement the methylols. The durability of the melamines partially overcame their relatively high costs, and cotton goods—especially in glazing operations—offered a very good outlet because the older urea resins were generally unsatisfactory. Too, the increasing research activity and promotion done in cotton's behalf had a great effect upon their acceptance. The consumption of melamine and modified melamines currently is of the third greatest importance in dry pound volume, or about 20% of the entire thermosetting resins output for textiles. Patent protections have limited the manufacture of melamines.

Much work has been done with urea and with formaldehyde. The Germans spent their largest effort during World War II using straight formaldehyde in treating their "all-purpose fiber," rayon. Perhaps this is another example of the "plumb line," although it's understandable that they were forced to use what they had available. Urea is highly reactive and very low in cost. We naturally expect to see the majority of resin research done with urea involved.

Many improvements of the urea-formaldehyde resins were made in many countries. Developments in Germany. Japan, England, and the US include formaldehyde derivatives of ethvleneurea. acetylene diurene resins, urons, methylated ureas and triazones. Any variations from the low-cost urea and formaldehyde affects the costs sharply.

In considering that the ethylene ureas occupy a volume position today that is second only to the original methylols, one is forced to ask what has taken place in the last few years to move this class up from one to two million pounds annual consumption to more than 15 million pounds. Recently, ethylene-ureas sold for about 30¢ per wet pound and were controlled by three (possibly two) companies whose positions were established with the ethyleneurea intermediate. Today, there are many suppliers offering prices reported to range well below 20¢, liquid. The "wash and wear" formulations for cotton finishing have given this chemical a good boost in volume requirements. Its resistance to chlorine allows for less washing instructions.

"Wash and wear" is commonly called the phenomenon of the day. The largest yardage of the goods with "wash and wear" characteristics finds an outlet in the field of men's and boy's wear, women's dresses, and children's wear. Surveys show "wash and wear" shirts for men and boys represent from 25%-60% of total shirt sales. A child's dress with "wash and wear" will outsell an untreated garment by as much as three to one, even at prices from one to two dollars higher. Resin-treated cottons are, in all fields, overwhelmingly best sellers. The man-made cotton blends are selling well, but the prices favor cotton products. One thing has been brought out that justifies our faith in the American lady consumer; regardless of the treatment the fabric has received, she will select the best-styled garment. The garment manufacturers all agree that if the "wash and wear" characteristics are present in the better-styled dresses, sales are instantaneous.

The question is asked, "where do we go from here and what finishing agents are due for replacement, and what substitutes are available?" We might well take a good look at ourselves and the position we occupy along with some conditions that have never before existed in this or any country. We are surely entering the "Golden Age of Textiles" and we are moving as fast into this era as our buying public can be educated to the vast wonders of finished textiles, and as fast as we can avail ourselves to a sufficient number of textile chemists who, in development and production, in research, and in quality control are vital to the success of our industry. As for the lady buyer, let us be assured that she already knows more than she is sometimes credited.

Our company has been associated with "wash and wear" since its beginning, and our staff has prepared countless "wash and wear" recipes of which many were acceptable to the buying public; but we do not, in any degree. believe the consumer absorbs all that is written on the tags and labels. Those magazines of spe-

cific interest to the homemakers, and particularly those that have departments staffed with highly qualified textile chemists, are doing a great job in creating more quality-consciousness in the consumer fields. The consumer is more often "calling the shots," the textile chemist is closer to the consumer than ever before, and the demands, complaints and satisfactions are more accurately received where salesmen's alibis are not misleading. (I'm a salesman myself and I "dig" the alibi). The intensified research efforts made at the finishing plant level, by the chemical manufacturers, by the synthetic-fiber manufacturers, by the National Cotton Council, and by many professional and government-sponsored institutions can and will be further expanded as the thoughts of the American youth again turn with interest towards textile chemistry as a vocation of his or her choice. There are scores of textile-chemical-research consultants who have become available and the industry is recognizing their importance more every day. My company supplements its own relatively high-cost research programs by contracting with several of these consultant houses. It's part of our growth. As for youth and its interest in textile chemistry, there are a number of efforts being made in this direction. Recent surveys indicate textiles to be a more rewarding field, financially and personally, than the country had been led to believe. From these surveys, recommendations for changes in the college curriculum are said to promise livelier and more rounded courses. What's more important is that chemical manufacturers, textile manufacturers, professional organizations, educators, and others are acutely aware of the shortage of trained, young people. The fact that something will be done is a foregone conclusion.

## DISCUSSION

Now, I believe we can all see where we are going from here, and for the question regarding the future of the organic finishing chemicals, you should know better than others that you are busy replacing them now with entirely new organic chemicals. Some exceptions might be those that will have been completely modified or improved beyond quick recognition.

Before we discuss water-repellent finishes, let me say that presently there is a new concept in permanent water-repellent finishing, which promises some unusual results, at costs lower than that of some of the current permanent processes.

WATER-REPELLENT FINISHES ——Somewhere between fifty and seventy manufacturers and compounders seek to supply this ten- to thirteen-million pound market for the textile finishing field.

Charles Macintosh became famous with a rubber treatment for raincoat fabrics back in 1824. The name "mackintosh" became associated with good rain apparel and, even now, the original "mackintosh" label appears all over the world in the lightweight coats. Only the name is the same, the goods have been improved all along, as we can experience air-permeable comfort in wearing them. The early waterproofing was done with almost any substance that would melt and spread continuously over the fabric. Asphalt, wax and pitch must have offered limited comforts. Continuous or impermeable coatings of many types of film-forming materials are used on fabrics of woven and knitted construction, as well as on nonwoven goods. Lightweight tarpaulins are being made tough, pliable, and almost tear-proof by coating solvent chloroprene rubber on both sides of nylon knit fabrics. Polyvinyl chloride, polyvinyl butyral, cellulose acetate and other materials are being used for continuous coatings for raincoats.

Water-resistant finishes are regarded generally as porous and processes for obtaining these finishes were known in the 19th century. The procedures involved passing the goods first through a metal salt solution, such as aluminum or lead acetate, and a second pass through a solution of sodium soap. The metallic soap formation on the fiber gave water repellency with air permeability. Obviously, the construction of the fabric is an important consideration in all permeable water-repellent goods. The single-bath method uses a wax-aluminum salt product. This process was known in this country about 1930 and fairly replaced the old two-bath method. The paraffin wax normally used is melted and worked into a water dispersion with some colloid, such as glue or gelatin, and homogenized prior to incorporating aluminum acetate or aluminum formate. These finishes are not resistant to laundering or drycleaning and are described as renewable because of the ease in which the clean garment may be reprocessed. The ready to use "renewable" water repellent products are 25 to 40% solids in water and sell at prices from 9¢ to 19¢ per wet pound.

The important quaternary ammonium type was the first durable repellent used in this country and was in process just before World War II. The chemical was designed to break down upon heating and leave a water-repellent residue on the fibers. Fatty pyridinium compounds and methylol stearamides with resins are among those currently available.

Silicones and fluorocarbons are relatively new products and have been very well received by processors and the buying public. The silicones (and methylol stearamides) are also used in conjunction with thermosetting resins for "wash and wear" formulations. These materials are very resistant to drycleaning.

SOFTENERS——The textile finisher has always had some means available to soften his goods. Early uses of fats, greases, and oils were inexpensive but the poor properties inherent in their makeup have restricted their use in view of the many stable, synthetic softeners available. These old materials suffered rancidity, discoloration, and lack of heat and light resistance. They are generally unacceptable in resin finishes.

Sulfonated tallows, emulsifiable mineral oils, wax emulsions, stearic acid and tallow soaps, and other natural greases are still used in huge quantities. Some recipes call for such large proportions of sulfonated tallow that the resultant weight gain of the fabric offsets the cost of the finish. The greasiness of tallows facilitates napping and other mechanical processes.

Sulfonated paraffins (Reed reaction products) have been used quite extensively for more than 20 years and their position is relatively secure because of the excellent effects produced and resistance to light and heat. Sulfated fatty alcohols and fatty acid condensates supplement the above items in the anionic group.

The cationic softeners group is comprised of hundreds of variations of substituted ammoniums and amines. The numbers of possible considerations of the chemicals and fats appear endless.

Nonionic softeners and lubricants are principally polyoxyethylenes and, again, there are no limits to the numbers of combinations, techniques and modifications. Siloxanes and silicone emulsions occupy a field of their own and no effort will be made to discuss them.

It is interesting to see water listed as one of the nonionics.

The use of softeners is made in almost any processing plant in at least one or two applications. Estimated consumptions in textiles appear, for all types of softeners and lubricants, to be running well over fifty million pounds annually.

FLAMEPROOFING FINISHES ———Cotton and rayon appear to have received the most attention in this field and the processing chemicals were mostly inorganic. A few chlorinated materials were exceptions and a few fairly important organic chemicals are used today. THPC is a process utilizing a phosphorous-formaldehyde derivative reacted with a thermosetting resin. There are several disadvantages reported, but it's one of the newest methods and is undergoing extensive study and practical application. Total estimate of five million pounds is principally limited to the nondurables.

Some current experiments with phosphorus compounds indicate the possibility of a flameproofing finish that will be durable without compromising the hand and strength of cotton and rayon to a great degree.

RUBBER LATEX———The almost countless means and methods of using these elastomeric materials in the processing of textile and related products make it difficult to describe them as belonging to a particular field. The manufacturers of transportation and furniture-covering cloth, such as frieze and pile fabrics, will usually apply rubber latex to the back of the goods prior to scouring and dyeing. This precoating practice applies to much of the scatter-rug processing. Another method of application calls for backcoating during the actual finishing operations and the results obtained qualify the backing as a finish. Many of these materials that enter what we refer to as "the textile field" do not emerge as such. Take those textile plants that have diverted latex, through their own processing, to the latex foam industry, as an example. Some suppliers of compounded latex have sold wet products that are prepared for use by the foam manufacturers. The many uses of latex in impregnating baths for fabrics, cords and warps; in dyeing and printing of pigments; in supporting nonwoven fabrics, make it extremely difficult to arrive at consumption estimates based on end uses. It is necessary that we discuss these materials as amounts consumed in processing textiles and related products.

For all practical purposes, the copolymers of styrene and butadiene, such as were identified as GR/S latices, make up the largest volume in use with textiles. There are estimates based on survey and trade report data that indicate from forty to sixty million dry pounds of GR/S types were consumed by textiles in 1957. Our synthetic-rubber industry, as we see it today, was rushed into being as World War II came on and the country found itself "fresh out" of the imported tree rubber latex. Patents covering textile latex processes were expiring when most of us were boys, but the textile industry has never depended on latex as it does today. The giant tufted rug and carpet industry has grown from its beginning, just after World War II, to the production of about forty-five million square yards in 1954 to over one hundred million square yards during 1958. This last production figure is based on first-half figures of over fifty million square yards and estimated 8-10% increase for the last half of 1958. Unlike woven carpets, the tufted types depend almost entirely upon a good, strong backing that locks the tufts. This material must be fairly flexible and rubber latex satisfies these requirements best, with lowest costs. It would have been most unfortunate if such a sizable field had existed when the natural latex imports were so short at the start of World War II.

Various estimates of the textile consumption of natural latex are from twelve to twenty million dry pounds during the year 1958. Natural latex has the ability to hold large proportions of clay fillers and other properties of the film are of interest. The prices are not as stable as synthetics and its aging properties are more easily influenced. Some users of synthetic latex are no longer concerned with copper contaminations as a result of having judiciously selected compounding ingredients.

The government-supported synthetic rubber program was actually operated on the production level by private business. The facilities were sold in 1955 and the synthetic rubber industry has expanded to include new and additional facilities as well as new producing companies. Incidentally, the government program was concentrated in elastomer production with styrene contents around 50% maximum. High-styrene, low-butadiene copolymers were continuing to be developed and manufactured by private business.

In addition to these principal latices, there are other recognized elastomers that account for relatively large portions of the overall textile consumption. Butadiene/acrylonitrile latex consumption is estimated in excess of seven million dry pounds. About two hundred and fifty thousand dry pounds of Neoprene latex were used in solvent-resistant coatings and in processing conductor (electrical) cloth in 1957.

Polyvinyl acetate emulsions occupy a very important place, according to the estimated consumption figures, for 1957, and some guesses for 1958. The total vinyl acetate monomer consumption for all industries is probably close to two hundred million pounds. This is used in vinyl chloride copolymers, butyrals, formals, alcohols and polyvinyl acetate emulsions for textiles, paints, adhesives, and chewing gum base. About 10% of total is exported and textiles probably account for about fifteen million pounds. One survey shows nine million pounds used in chewing gum in 1955.

Textile finishing requires polyvinyl acetate emulsions with properties that might not be found in many products that are made expressly for the paint and other fields. The textile finisher sometimes adds polyvinyl acetate to starch mixes that are cooked to high temperatures and the mix must not kick out. He requires a polyvinyl acetate that doesn't stick to and "build up" on surfaces of hot processing equipment. In addition to these, there are compatibility considerations that are necessarily made in some processes.

Polyvinyl acetate has wonderful adhesive properties and produces very stiff finishes. Some goods are treated with enough softener present in the polyvinyl acetate bath to allow considerable pickup with most of the handle gain resulting in "body" rather than firmness. Crosslinking agents can be added to the bath to provide more resistance to water. It has been found recently that the stiffening efficiency of polyvinyl acetate can be increased to such a point that processing savings are obtained.

Our company produces several modifications of the straight type polyvinyl acetate emulsions as well as a series of copolymers with ethyl acrylate and other internal plasticizers. It was necessary to develop these specialty emulsions with such processing economy as to allow ourselves a very competitive place, even against the single purpose "paint grade" emulsions.

## CONCLUSION

I have discussed a few of the most generally accepted organic finishing agents. There are literally hundreds of other materials and considerations that would fall in this category.

Textile wet processors many times move with incredible speed when developments in the retail field indicate the necessity. Their quick response to the frantic demands for coonskin imitations, during the "Davy Crockett Craze," has credited them with saving the American Pussy Cat from extinction.

# III. Surfactants—Present & Future

**CARL A BERGMAN**
*Assistant Branch Manager*
*General Aniline & Film Corp*
*Charlotte, NC*

## INTRODUCTION & HISTORY

SURFACTANTS had their start in Europe and, as with many other developments, war played a part. During World War I, Germany suffered shortages of raw materials, and efforts were made to replace products with synthetics. One such development took place in 1916, at Hoechst's laboratories, where a benzyl naphthalene sulfonate was produced and used with excellent success as a dyeing assistant for wool. This product was marketed as Leonil S. A year or so later, at Badische's laboratories, the diisopropyl and the butyl naphthalene sulfonates were made and sold as wetting agents under the trademark Nekal. These materials are the original prototypes of *modern* surfactants and are still produced in relatively large tonnage. While it is certainly true that the sulfated turkey red oils were already known, we think the development of the sulfonated naphthalene derivatives opened a new era in the field of surface-active chemistry.

There were other surfactants to come out of Europe and I would like to refer any interested person to Carl Z Draves' paper entitled "Textile Chemical Specialties" (*1*). German scientists were remarkably successful in the search for products that had better scouring and detergency properties than the original naphthalene adducts. They developed:

1) The fatty acid esters of hydroxy ethane sulfonic acid, originally marketed under the trademark Igepon A, and the fatty amide sulfonates originally marketed under the trademark Igepon T.
2) The sulfuric acid esters of fatty alcohols marketed originally under the trademark Gardinol.
3) The alkyl benzene sulfonates; which were never fully exploited in Europe until recent years because of the lack of petroleum raw materials.

The commercial development of alkyl benzene sulfonate was accomplished by National Aniline when Nacconol NR was introduced in the United States about 1937. After World War II, petroleum companies such as Atlantic Refining, Oronite and others entered this market in a large way to supply the base alkane as well as the alkyl benzene sulfonate itself. Currently, this type of surfactant represents the largest tonnage of all surface-active agents—over 450,000,000 pounds of 100% active material was produced in 1957.

Another development of importance took place in 1930 when Schoeller & Wittwer patented (*2*) the use of ethylene oxide as a solubilizing group. This was the commercial realization of the nonionic surfactant. The original nonionic types were based on fatty acids or alcohols and it was not until a few years later that Steindorff et al (*3*) invented the alkyl phenol derivatives, which today represent the largest single class of nonionic surfactants.

In the United States, production of surfactants did not start on a large basis until the mid '30s. While many of the original structures came out of Europe, it certainly can be stated that America exploited these materials and produced them in such tonnage so as to put them in the bulk chemical class. The U S Tariff Commission Reports for 1957 show a total production of over one billion, two hundred million pounds of surfactants based on 100% activity.

Once the commercial values of surfactants were realized by American industry, we witnessed the invention of a number of structures here such as the esters of sulfosuccinic acid, ie, Deceresol OT; the secondary alcohol sulfates, ie, Tergitol; the sulfated fatty acid mono glyceride, ie, Artic Syntex M; and the fatty alkylol amide, ie, Ninol products; to mention a few. The writer believes, however, that the significant contribution in the United States was the great strides made by the chemical industry in the development and production of base intermediates for the manufacture of surfactants. It is a matter of record that American industry made available olefins for large-scale production of alkyl benzene sulfonate and oxyethylated alkylphenols. Other developments were the commercialization of oxo alcohols, the fatty amine and amide intermediates as well as the production of low-cost ethylene oxide. These are some of the developments that have made it possible to offer a variety of surfactants of high quality and low cost to our industries.

It can be stated that the majority of surfactants were originally developed for the textile industry, and textile people can be proud to realize that they were the original users of such products. It shows this industry is ready to accept progressive ideas when they are offered. In this discussion of surfactants we include detergents, wetting agents, emulsifiers and dyeing assistants. We have purposely excluded finishing agents since it is better to consider these products in a group by themselves.

## CLASSIFICATION AND USES

Surfactants can be classified in different ways. We have chosen to do this first by their chemical ionic characteristics and second by their "function" in textile processing.

Table I shows a classification based on chemical ionic characteristics. You

**TABLE I**
**Chemical ionic classification of surfactants**

| *Dissociated type* | *Examples* |
|---|---|
| Anionic | $R - C_6H_4SO_3^- Na^+$<br>Alkyl benzene sulfonates |
| Cationic | $R - N(H^+)(/(CH_2CH_2O)_xH)(-(CH_2CH_2O)_yH)\ HSO_4^-$<br>Hydrosulfate salt of oxyethylated amines |
| Amphoteric | $R - C(=O) - NHCH_2CH_2N(H^+) - CH_2COO^-$<br>Fatty amino – amide condensate |
| *Nondissociated type* | |
| Nonionic | $R - C_6H_4O(CH_2CH_2O)_xH$<br>Oxyethylated alkylphenols |

**TABLE II**
**Important surfactant types and their functional uses in textile processing**

| | *Detergency* | *Wetting* | *Emulsification* | *Dyeing assistants* |
|---|---|---|---|---|
| Soap | X | | X | |
| Oxyethylated alkylphenols | X | X | X | X |
| Alkyl benzensulfonates | X | X | | X |
| Alkyl sulfates | X | X | | X |
| Sulfonated amides | X | X | | X |
| Sulfonated esters | | X | | |
| Oxyethylated alcohol & acids | | X | X | X |
| Alkyl naphthalene sulfonates | | X | | X |
| Sulfated oils & fats | | | X | X |
| Petroleum sulfonates | | | X | |
| Alkylol amides | X | | X | |
| Oxyethylated amines | | | | X |
| Quaternary ammonium salts | | | | X |

will note there are two broad classes; namely the *dissociated class*, which includes the anionic, cationic and amphoteric types; the *nondissociated class*, consisting of the nonionic types. This division is based on the presence or absence of an electrical charge on the hydrophobic portion of the molecule. This is a convenient way to group these products since it is one of the first considerations in selecting surfactants for textile processing.

Table II shows a classification based on the function that a surfactant performs. We have divided the functions into four headings; namely, detergency, wetting, emulsification and dyeing. Also, surfactant types are shown indicating their most useful function. A classification of this type is difficult because many surfactants have multiple functions. It is difficult to include all the functions and still maintain a clear, concise and understandable arrangement. For this reason it is best to examine some of the typical functions in more detail.

DETERGENCY———Let us consider detergency first, because this function consumes more surfactants than the others. Detergency in textile processing differs widely from laundry or home washing. Broadly, it falls in two categories; one is the preparation of the raw stock, yarn or piece goods prior to dyeing and finishing, and the other is the soaping of fast-dyed or printed fabrics and yarns. In the preparation of cotton, an alkaline treatment is conducted with caustic soda at the boil and even under pressure, as in kier boiling. In this operation a surfactant is used to solubilize and disperse the wax impurities that are saponified by the caustic soda. The surfactant has to be chemically stable to caustic and maintain the desirable properties already mentioned. Typical surfactants used in this application are fatty amide sulfonates, the oxyethylated alkylphenols, the alkyl benzene sulfonates and the modified nonionics, such as the phosphate or sulfate esters. Actually, in cotton preparation, piece goods represent the largest segment because about 75% of cotton is processed in this form. The major share is run continuously either through J boxes or open-width machines.

In wool preparation, there is the raw stock scouring operation to remove the natural impurities, such as wool grease, suint, sand and dirt. These impurities often represent up to 60% of the weight of the fiber. The trend today is toward the neutral scouring process (*4*) using the oxyethylated alkylphenols as the detergent. This process eliminates the necessity of soda ash, which is the usual practice with soap or anionic surfactants. It results in considerably whiter wool with more loft and openness of the scoured stock.

Other wool detergency functions are the cleaning of yarns and piece goods to remove spinning oils. Again, the nonionic oxyethylated alkylphenols have found favor because of their high cleaning value and good rinsing properties.

A third application, broadly classified under detergency, is the fulling or milling of wool piece goods. This is a controlled shrinkage process, which imparts desirable properties to wool and worsted fabrics. A lubricant and plasticizer is needed to protect the fiber and reduce the friction generated in the process. Soap has been used for years to accomplish this; however, surfactants have made large inroads on soap for this application. Surfactants that have enjoyed excellent success in fulling are the fatty alkylol amide condensates and the fatty amino—amide amphoteric materials, particularly in alkaline fulling. Acid fulling is practiced and undoubtedly will continue to grow because it offers the possibility of improved fabric strength, less fly, less color bleed and staining on fancy constructions of fabrics. In many cases fulling is run "in the grease", which means the spinning oils are present. In such cases, a scouring operation follows and either the fulling solution functions as a detergent or more surfactant is added. Here again the oxyethylated alkylphenols have found wide acceptance; however, other types, such as the alkyl benzene sulfonates, the fatty alcohol sulfates and the fatty amide sulfonates, are used.

In the processing of synthetic fibers, the preparation stage is not as difficult. The impurities requiring removal are the lubricants and sizing compounds put on to process the stock to yarn and fabric. This is usually accomplished with the previously mentioned detergents used on cotton and wool; however, smaller quantities are used and the temperature and processing is considerably less severe.

The second major use for detergents is the soaping or removal of unfixed dye. By far, the largest outlet is in soaping cotton because this fiber is usually dyed or printed with fast colors requiring a hot soaping treatment to develop the proper fastness. Surfactants having good detergent properties are used, as shown on Table II.

WETTING———Wetting agents are another tonnage outlet for surfactants. Their application is very wide and diversified and it is beyond the scope of this paper to list them all. A few should be considered, however, and some of the major uses are:

1) Wetting in size baths and desizing liquors.

2) Wetting of greige cotton yarns prior to dyeing.

3) Wetting and penetration of piece goods particularly when dyed continuously at high rates of speed.

4) Wetting of resin and other finish liquors on piece goods to insure uniform penetration of the fabric.

There are many requirements the surfactant must meet beside good wetting properties. For example, in desizing, the wetting agent cannot adversely affect the function of the enzyme. This limits the types that can be used and the two that have enjoyed most success are the nonionics oxyethylated alkylphenols and the esters of sulfo-polycarboxylic acid. In wetting of greige cotton yarn, the agent should not coagulate the finely dispersed vat dye particle nor should it retard the vat color excessively during the reduction dye cycle. The alkyl benzene and naphthalene sulfonates as well as the sulfonated aliphatic esters of oleic acid are known to have good properties in these respects, whereas the oxyethylated alkylphenols adversely affect the vat colors.

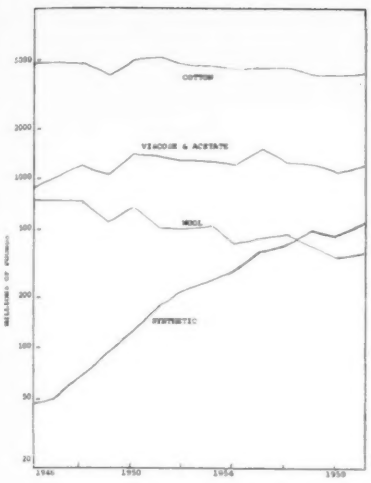



**Figure 1**
**U S fiber consumption, 1946-1958**

Other properties required of wetting agents are low-foaming characteristic and compatibility with thermosetting and reactant-type resins. These varied properties are the basic reasons why so many types of wetting agents are offered to the textile processor.

EMULSIFICATION ——— In considering the function of emulsification, we are again faced with many applications. There are two well-defined uses; one is in wool and worsted spinning oils and the other is in lubricants for synthetic fibers.

Wool and worsted spinning oils use petroleum sulfonates, amine soaps and some nonionic emulsifiers, alone or in various combinations. The trend in the woolen industry has been to use water-soluble lubricants, and the polyalkylene glycols and oxyethylated amines are receiving consideration because of their desirable effects in fulling and ease of scourability from the fiber.

Synthetic-fiber lubricants is a highly specialized field since each man-made fiber requires a particular finish. Emulsifiers are an essential part of such formulations and a variety of nonionic oxyethylated condensates as well as petroleum sulfonates are used. These emulsifiers often serve a dual function, imparting antistatic or some other valuable property to the final composition.

DYEING ASSISTANTS———In the consideration of dyeing assistants, it has to be realized that the end uses are more diversified than the previously mentioned groups. In this respect it is more highly specialized than the wetting agent group. This is readily understandable with the vast number of fibers and types of dyestuffs that are used by this industry. The problem is becoming more complex because of the many blends of fibers and the constant demand put on dyers to improve the appearance and quality of the dyed yarns or fabrics. Dyeing assistants function either by preferential absorption on the fiber, which temporarily blocks the dye site, or by a temporary association with the dye molecule itself, which retards the rate of exhaustion on the fiber. There are other functions, such as solubilization or dispersion of the dyestuff, but for our purpose the important fact is that demand for improved dyeing assistants is increasing because of the tremendous development of synthetic fibers in recent years.

Some of the prominent applications for dyeing assistants are:

1) Use as a stabilizing agent with fast color salts and bases in naphthol dyeing. These products are usually nonionic oxyethylated types.

2) Retarding and leveling assistants for vat dyes on cotton. The ligno sulfonates are used widely in this application, but oxyethylated alcohols and amines are also used with excellent success.

3) Requirements for dyeing assistants on synthetic fibers vary according to the particular fiber and type of dye. There is need for dispersing agents for the dye, emulsifiers or solubilizers for the carriers as well as retarding and leveling agents.

**TABLE III**
**Estimate of surfactant consumption in textile wet processing — 1955**
**(millions of pounds)**

| | *Cotton Trade* | *Wool Trade* | *Synthetic Trade* | | *Totals (poundage)* |
|---|---|---|---|---|---|
| Detergents | 14.5 | 19.1 | 5.9 | = | 39.5 |
| Wetting agents | 12.5 | 0.3 | 1.1 | = | 13.9 |
| Emulsifiers | | 3.1 | 1.9 | = | 5.0 |
| Dyeing assistants | 9.5 | 2.2 | 2.6 | = | 14.3 |
| Total poundage | 36.5 | 24.7 | 11.5 | | 72.7 |

Grand total surfactant consumption = 72.7
(in millions of pounds)

## VOLUMES

Estimating accurate consumption of surfactants in the textile industry is a very difficult, if not almost impossible, task. The usual methods of direct or indirect survey do not work because companies are reluctant to give types and poundage of products used and also because many surfactants find their way into the textile industry through companies that compound or formulate special products. Some years ago our company realized that, while no accurate accounting could be made of surfactants used in textile processing, it was possible to obtain a relative estimate of their consumption. The system we used was presented before the Chemical Marketing & Economics Division of the American Chemical Society in a paper by Brandt & Gantz *(5)*. Briefly this system is based on setting up typical processing formulas for the various wet stages through which textile fibers pass. By calculating the poundage of fiber consumed from the Bureau of Census Reports and proportionating this poundage through the correct wet-processing stage, one can estimate the amount of surfactants used. Table III shows such an estimate for the year 1955 based on this system. You will note that tonnages are given in millions of pounds, for each trade, namely; cotton, wool and synthetics as well as for the surfactant categories of detergents, wetting agents, emulsifiers and dyeing assistants.

The author wishes that these figures could be up-to-date, but time did not permit and no figures are available on exact fiber consumption beyond 1957. There was an approximate decline of 4% in fiber consumption in 1957 compared with 1955 and it would be logical to assume a proportionate decrease in surfactant consumption for 1957—by this system.

## TRENDS

As we have stated previously, the estimates shown in Table III cannot be taken as accurate figures. They are useful however as a guide in developing and marketing surfactants. An interesting observation can be made from the comparison of figures for surfactant consumption to fiber consumption. Figure 1 shows fiber consumption for years 1946 through 1958. Cotton consumption has held steady over the past eight years; however, wool has declined considerably while man-made fibers have had phenomenal growth. By comparing the estimated poundage of surfactant to the poundage of each fiber con-

sumed in 1955, it becomes evident that approximately

| | | owf |
|---|---|---|
| 0.8 lbs surfactant | is used per each 100 lbs | cotton (0.8%) |
| 5.8 lbs " | " " " " 100 " | wool (5.8%) |
| 0.6 lbs " | " " " " 100 " | synthetic (0.6%) (including viscose & acetate) |

It is obvious from this breakdown that wool uses the largest quantity of surfactants on a percentage basis. One might conclude that surfactant consumption will decrease because wool consumption has declined. This is not necessarily true because surfactants continue to make inroads on soap in wool processing. Examples are raw wool scouring and fulling operations; also, suitable surfactants are being adopted as wool-spinning lubricants replacing mineral and vegetable oil types.

In the cotton industry, the market for surfactants should continue to have moderate growth since these "service chemicals" are very useful additives in wet-processing operations. This fact, together with the progressive attitude adopted by the cotton industry toward up-grading its product through chemical modification technique in cotton finishing, will insure a continued demand for this fiber.

In the case of synthetic fibers, we are witnessing increased markets for surfactants. These markets are for dyeing assistants, antistatic agents, carriers and detergents. Also, expanded markets are developing for surfactants in fiber finishes, particularly on man-made synthetics. These finishes impart antistatic and other desirable lubricating properties necessary for carding, combing, spinning and drawing operations.

Over the past few years many fiber manufacturers have up-graded rayon tire cord and I am certain all of you have heard of the Tyrex rayon program. Viscose modifiers have played an important part in this program. These modifiers are usually surfactants added to the viscose dope or spinbath to impart better tensile strength to rayon. This has created an *additional* multimillion pound market for *surfactants*. Besides rayon tire cord, work is in progress to improve textile—rayon properties through viscose-modification techniques, which could have a further impact on the surfactant market.

Regarding the types of surfactants that will increase, we feel nonionics such as the oxyethylated alkylphenols and alcohols will continue to grow at the expense of types such as alkyl benzene sulfonates, fatty amide sulfonates and fatty alcohol sulfates. Currently, at least 30% of surfactants consumed in textiles are nonionic oxyethylated types. Growth should also continue for the modified nonionics, such as the sulfate, phosphate esters and other *adducts*, since these products often carry the desirable properties of the original nonionic without certain undesirable characteristics.

Considerable hope is also held for the amphoteric group of surfactants. Some types already are well established in such uses as fulling agents for wool and as softeners for yarns and fabrics. These products can be designed for a wide range of compatibility with other surfactants (anionic, cationic or nonionic) and some have excellent solubility in presence of large amounts of electrolytes.

It is the author's opinion that surfactant development will continue at a high rate; however, this development will not be primarily directed to the textile industry. While it was once true that these materials were originally made for the textile industry, major research today is toward the larger household and industrial surfactant markets. The textile industry will benefit, however, because greater development activity will result in new surfactant structures with inherent properties needed in wet textile processing.


## ACKNOWLEDGMENT

The author wishes to acknowledge helpful comments by his colleagues at General Aniline & Film Corp. Special acknowledgment is made to G M Gantz, Richard Berger and Grace Proctor, who assisted in the preparation of this manuscript.


## REFERENCES


(1) Draves, C Z, *Am Dyestuff Reptr* 35, P641 (1946).
(2) Schoeller, C, & Witwer, M: U S Patent 1,970,578.
(3) Steindorff, A, Platz, C, & Rosenbach, J, U S Patent 2,111,820.
(4) Hansen E C, *Am Dyestuff Reptr* 47, P155 (1958).
(5) *Chem Eng News* 35, 124-128 (August 5, 1957).


# IV. The Textile Finishers' Challenge to the Chemical Industry


**GEO O LINBERG**
***Executive Vice President***
***Melrose Chemical Corp***
***Melrose, Mass***


## INTRODUCTION

THE original request for this paper had a tragic note or ring when it requested that . . .

"We would like you to present a 'blue sky' approach to textile finishing. What new processes can you envision? What new properties should finishing impart to textiles? What should the chemist be striving for in his research efforts? Basically, what is the future of textile finishing?"

I believe that this request was made on the rather shaky assumption that I would be around twenty-five years from now to see if any of my assumptions, or predictions would come true. In spite of that remote possibility, I have some thoughts that might intrigue you, I hope.

## DISCUSSION

One of our largest finishers of textile materials in this country has recently (within the last two or three years) come out with a new finish for its goods predicated on an important factor, namely, a pretreatment of cotton to give it characteristics which are not inherent in that fiber. This chemical reconstruction or modification of the cotton fiber was originally discovered in 1854, but it was just recently that an alert textile finisher made use of this discovery. This is not an uncommon case, for the time between a fundamental discovery and its industrial application may be decades or even centuries.

The sulfa drugs for the treatment of bacterial infections, ie, sulfanilamide—aminobenzenesulfonamide first used for treatment of bacterial infections in mice in 1935, was first synthesized by Gelmo in 1908. Originally sulfanilamide was used as an "intermediate" in the manufacture of dyes with better-than-average fastness to washing.

The reverse of this illustration has also been true, as we have found some exotic chemicals primarily produced for use in blood plasma now in general use in textile finishing.

This is polyvinyl pyrrolidone, synthesized by Reppe in 1930. It has found extensive use in the textile industry, as suggested by Hansen et al (*1*) at the 1953 Convention of the American Association of Textile Chemists and Colorists. Please note the lapse of twenty-three years before it was presented as a new product of potential use in the textile industry, although it was well known as a blood-volume expander and as a protective colloid-suspending agent in many drugs. It has various uses such as a "chill-proofing agent" in beer, a clarifying agent in wines and in dentifrices, and for reducing or preventing the staining of teeth by coffee and tobacco.

These illustrations are given to indicate that, when looking into the future for useful textile chemical products, one must examine carefully what has gone on before. These illustrations are reasons enough to have your research chemists look into chemicals that are used in fields other than textiles. The search will be profitable!

Looking back over some of the literature and some of the work that has been done for the textile industry, I want to emphasize again the lapse of years that took place between the chemical inception of materials that later proved to be very suitable and salable in the textile market.

We have a number of suppositions as to what is to come, based on what is going on now in textile finishing.

Natural fibers are not being replaced but augmented by chemically produced fibers, and this augmentation will continue and expand. However, to really make a "blue sky" approach, could we, perhaps, change the diet of the sheep so that they will produce wool of additionally advantageous properties, or even various kinds of wool to fit specific applications? What is to prevent the researcher from feeding the cotton plant chemicals which will produce a fiber that is fireproof, waterproof, mildewproof, soil proof and so on down the list of desirable properties? Now we are attempting to accomplish these objectives by considering that our cotton is cellulose, and as such, is reactible with other chemicals, such as finishing agents, to produce a new chemical fiber. Our new reactive dyestuffs dye cotton in this manner. At the moment, textile chemists are beginning to be interested in finishing agents which chemically react with, rather than merely add *physically* to, the fiber.

We add resins to cellulose to stabilize the fabric during laundering and give high wrinkle resistance. In so doing, we weaken the fabric (not the fiber). Why can't we resinate to produce the desirable properties and actually increase the strength of the fabric? This means the extended use of selected resins, including the development of *new* chemicals to effect proper cross-linking in cellulose.

One of the major problems in this country which will *not* get any better unless chemicals come to the rescue is stream pollution. The need for synthetic warp sizes, which after use and disposal will not rob streams of their oxygen, is a problem at our doorstep *now*. In the immediate future, we look to the research chemist to solve this problem. The market for the right chemical or chemicals is very great. This problem is one of many that are with us now, so to look to the future it behooves us to study the problems we have today.

One of our leaders in the textile industry recently stated that almost two billion yards of cotton fabric were resin-finished for crease resistance or "wash and wear." This is about one-fifth of all cotton wide apparel goods. He predicted that another year or so would find the resin-treated portion up to five billion yards.

Anyone familiar with the use of thermosetting resins in textile finishing would have to grant that the past decade has seen a tremendous development in progress. Ten years ago, textile resins of the thermosetting type were practically limited to the various simple urea types with some volume in melamines. Since then have emerged the so-called cyclic ureas (dimethylol, ethyleneurea), the epoxys, the triazones, the glycol-acetals, the pentaerythritol acetals, and a host of exotic formers or reactant materials.

Perhaps one of the most interesting new possibilities lies with the new APO resin announced by the Southern Regional Research Labs of the U S Department of Agriculture. This has a background of German development work, and the inhibition to exploitation in the American market lies with the unavailability domestically of ethylene imine. (Since this was written, we note ethylene imine is being manufactured here.)

The man in the street has mixed emotions as to the virtues of "wash and wear" and the chemist has sympathy for his plight. The product in the hands of the public is highly variable as to performance, to the extent that the movement has sometimes been tagged as "wash and swear." The trouble lies with the textile industry's traditional inability to merchandise sensibly, its tendency to cut corners to meet cut-throat competition within its own borders. Thus, it has almost cut the development off in its youth by maintaining inferior standards, and more so by unethical operators labelling goods "wash and wear" that are far below accepted standards.

There is room for technical improvement, and a large market awaits the producers of better finishing agents. The crying, and I may say the coming, need is for cotton and rayon fiber modifiers, which will make these fabrics truly "crease resistant" and "wash and wear" with little or no damage to other physical properties of fiber or fabric. At the moment considerable compromise has to be made with respect to tear strength and abrasion resistance. Most of the modern resins react unfavorably to chlorine bleaching and others, which have good resistance to chlorine, suffer from souring after bleaching. Few of them can stand up to continual commercial laundering without fairly rapid attrition of the resin and the good properties imparted by the resin.

The future can and probably will hold for us a number of resins that will impart strength to the fabric and keep the crease angle as well as abrasion and tear strength above the untreated fabric—this is distinctly for the future!

For the future I see resins free from chlorine damage one way or the other, and the development by the chemical industry of not only safer bleaches but completely safe bleaches.

We must remember cotton is seventy percent of the fiber market and it will probably remain traditional to bleach by some means to retain pristine whiteness. An alternative? Feed the cotton so that it has this pristine whiteness when it is plucked from the plant. In the welter of tradition and practice it has been taken for granted that bleaching eventually damages cotton to the point of severe strength loss. There is no reason to believe that better bleaching cannot be developed to the extent that fiber damage is negligible or not at all. The development of such materials is in progress and awaits market development.

At the present time there is greater need for the development of fiber lubricants that are more effective. Many people are under the delusion that the low tear strength of resin-treated cottons is due to the resin treatment alone. They frequently forget that a print cloth off the loom has a tear strength of about three pounds, and that the desizing, scouring and bleaching removes the natural waxes of the fiber to the extent that, at the prefinish stage, the tear strength is down to about one and one-quarter pounds. The further loss in treatment due to the nature of the resins is

really more or less the straw that breaks the camel's back.

Untreated fabrics, presently, can be lubricated to restore the original tear strength, but the nature of the lubricant is such that it cannot do that well in conjunction with the resins, even though the intrinsic strength of the fabric is not greatly altered by the resins.

The above discussion is predicated on the assumption that those necessary materials and techniques will be found. The textile industry has long been a heavy consumer of the products of the chemical industry and it is safe to say this will continue. The market is there and will consume large tonnage quantities. That this is true is evidenced by the entrance of more and more large chemical companies into the field. Some are making their entrance with new synthetic fibers; Dow with Zefran, Goodrich with Darvan, Cyanamid with Creslan. Several have fibers in the vanguard. To this list must be added Shell with epoxy resins, General Electric and Union Carbon with silicones and other newcomers with specialized products with predicted merits.

The wedding of cotton and wool with synthetic materials, or the wedding of various materials to produce proper types of blends together with proper finishing techniques will be worked out in years to come. This will mean designing, styling and merchandising methods that are not even in the dreaming stage today. You will note I said "synthetic materials" and not specifically fibers, for in textiles we now have a host of materials that are not fibers. To name a few: paper, leather, synthetic foams, synthetic furs, foil laminates, films, extruded plastics, etc.

The newer reactant dyestuffs are of great significance and the whole area of dyeing technology is undergoing a reexamination to explore new ways of styling fabrics for today's market. As that is a field unto itself and not in today's discussion, we comment no further than to say the speeding up of dyeing will require, besides new dyestuffs, new chemicals to aid in that technique.

Perhaps one of the greatest areas for the organic chemist is in the field of polymer research. He is studying modification of polymer structure to allow easier dyeing of synthetic fiber materials. He must introduce active groupings into the polymer structure to accommodate the application of dye. Fibers like nylon, Orlon, Acrilan, and Dynel have severe limitations as far as stvling is concerned because of their difficult dyeing properties.

A yet unfulfilled dream that should come true within the next two decades is the creation of a new protein fiber duplicating the marvelous virtues of wool. When we speak of the virtues of natural fibers, we speak with more conviction every day as our acquaintanceship with the synthetic fibers increases. Our synthetics are good but they have a long way to go. Wool is not losing ground, on an absolute poundage basis, although percentagewise its consumption is lower as synthetic fiber production increases. As the world's population increases, the supply of wool may soon be inadequate for the potential demand. Our look into the future tells us that the processing of wool in fulling, scouring, decatizing, dyeing, etc, will all be on a continuous basis because of the invention of new machinery and new chemicals.

The world supply of cotton is still excessive, but is not much in advance of consumption as the surpluses are a holdover from previous years.

Just as a degression, but one that should point up your place as organic chemical producers in this textile picture, the cotton textile market took a severe jolt in the late forties and early fifties when rayon replaced it for tire cord. The transition was gradual, but would have been catastrophic had not opposite transition occurred in the textile market. Cotton had been taking a beating in the apparel industry with the advent of the rayons, acetate and viscose, to the extent it had to be content with the low end of the business. The factor that made for a sudden change was the application to cotton of the techniques of resin treatments of rayons, which helped rayon so much.

You, or at least your wives, are all familiar today with the Everglaze developments; the glazed chintzes, the embossed cottons, the wrinkle-resistant cottons. Suddenly cotton came alive and emerged from its stable gingham sort of business to high-styled resort and apparel wear. You began to see cotton evening wear on the ladies that rivaled the most sumptuous silks, and the price was silky too.

In the brief span of years when rayon replaced cotton for tire cord, the entire amount of cotton was diverted into gains in the apparel field. Your resins and other finishing chemicals spelled the difference. How big was this swing? A mere half billion pounds of cotton accounts for, perhaps, twenty-five million pounds of resin solids for this increment alone.

What about the great new field of nonwovens? You will produce newer, cheaper, and better binders to hold these structures together. Nonwovens are a far cry from the white hope they seem to be. In many cases they are more expensive than the wovens they propose to replace. The nonwoven fabric technologist is gaining a very high, if sobering regard for the overlooked engineering principles in woven fabric structure. Nevertheless, the market for nonwovens will continue to expand, and with it, the large volume of resin binders required for these applications.

While much has been done in the textile industry chemically and physically, really we are only in the infancy as far as a scientific approach is concerned. Controlled finishes, whether they be physical or chemical, are in the minority.

I can see, in the foreseeable future, machinery built to specification that will produce certain effects on fabrics; by way of physical and/or chemical methods. These will be engineered in the same manner as steel rolling equipment, with controls that for the textile industry today seem to be fantastic. These are within the realms of possibility of engineering and instrumentation today, and it will take men of vision to make them tomorrow's reality.

## ACKNOWLEDGMENT

I am deeply indebted to Henry A Rutherford of North Carolina State College, Francis K Burr of Fabric Research Laboratories, Inc and Warren Parsons, technical director of Sayles Bleacheries for their help, ideas and thoughts in this attempt to forecast some of the things that will benefit the textile industry.

## CONCLUSION

You were very kind to ask me to present ideas of what is to come. Having lived well over half a century, I believe my generation has seen the greatest spectrum of technological change of any generation that has inhabited the earth. I can remember the horse car, the kerosene lantern, the chic-sale and the bicycle in my early youth, and have seen the birth of the automobile, the airplane, vat dyes, resin finishes, synthetic fibers and plastics, the atom, and missiles.

I can but feel that most of the above predictions will be realities in the time left for me by the Almighty. I sincerely hope so. Thank you for your many kindnesses.

## LITERATURE CITED

(1) Hansen, E C, Bergman, C A, and Witwer, D B, "Polyvinyl Pyrrolidone: A Versatile Compound with Potential Textile Uses," *Am Dyestuff Reptr* **43**, No. 3, P72 (Feb 1, 1954).

# THE MARKET SHOP

## V. Introducing a New Starch Size

JAMES P CASEY
*Director of Applications Research*
*A E Staley Mfg Co*

THE story started one day about four years ago when a chemist in my company's Starch Products Development Laboratory discovered a new process for the commercially feasible preparation of starch acetates. Very quickly, we recognized this as a major breakthrough in starch chemistry. Right at this point a decision had to be made—which often comes up in chemical research—whether to work out all of the basic chemistry of this new reaction or to rush into commercialization of some of the products.

Now it happens that our Textile Laboratory is right next door to the Starch Development Group and they in a way decided this question for us. Because the Textile Laboratory works closely with our Sales Department, and has a distinct sales outlook, they want *products* right away. Thus, while the Starch Development Laboratory continued its basic research into the chemistry of the new process, the Textile Laboratory started work on applications in the textile field. They had long wanted a starch product which would size synthetic yarns and they reasoned that this new discovery might make it possible to introduce substituent groups into the starch molecule which would improve the adhesion to synthetic polymers. Would starch acetate adhere better to cellulose acetate fibers than regular starch? Initial adhesion tests were made and the results showed that it would. Data on the size of the cellulose acetate market was readily available—both for filament and spun —and by a simple multiplication the amount of warp sizing agent involved was computed. Since this was a sizable figure, we decided to proceed with the investigation in this area.

Our next step was to send laboratory samples of starch acetates to a manufacturer of cellulose acetate yarn. Their laboratory investigated these products and reported that they were more effective than any other starch for sizing cellulose acetate filament fiber (although unfortunately they were not as good as the sizes customarily used). It was then reasoned that, if these starches were nearly good enough on *filament* acetate, they should be much better on cellulose acetate *spun* yarns on which regular starch is used. An evaluation program was set up in the Textile Laboratory, and this showed this premise to be true.

We then looked over the textile sizing field for other applications. Root starches have always been the principal sizing agent for fine combed cotton yarns. Would starch acetates be applicable here? Laboratory testing showed that the paste properties were similar to those of root starches. Another call to our Sales Department disclosed the size of the root starch market for fine combed cottons, and since this too was sizable, we set up another laboratory evaluation program. Unfortunately, however, the sizing differences looked for in fine combed cottons are so difficult to detect in the laboratory that we soon came to the conclusion that any evaluation of this idea would have to be done under commercial conditions.

We now had concepts for two new warp-sizing starches—one as a size for spun yarns containing cellulose acetate fiber and another as a size for fine combed cottons. We had enough data and experience in our Textile Laboratory to be reasonably sure of success with these two products. We were now ready for commercial field testing.

The Sales Department had been following developments in our Textile Laboratory with great interest. Our next step was to sit down with them to plan a comprehensive field test program. What we were able to do from then on was made possible by the fact that all of our textile field representatives are technically trained for the textile industry. Some companies might, at this stage, announce a new product for sale, but it has become our policy to completely field test every new industrial product until we have collected complete performance data under operating conditions. The first step in setting up our field test program was to hold a meeting with our textile sales representatives during which our laboratory textile technologists explained the product concept, characteristics, and potential applications we visualized. At the same time, the market figures we had obtained earlier were reviewed and commented upon. Also, individual accounts were gone over to select a suitable list for field testing. After agreement was reached, contact was made with these companies, either by our textile chemists or by our textile representatives, and field tests were lined up. Tests were supervised by our laboratory textile technologists. In the course of this program, several changes in product definition were found to be necessary and these were eventually incorporated into the product to produce a complete product line, which we now refer to as our Miralloid and Mira-Film starch acetate gums.

The last step has been the preparation of advertising brochures, which were prepared by our Sales and Advertising Departments with the assistance of our textile chemists who supplied the technical ideas and data which are given in the brochures.

This completed the role of the Applications Research Department in this development since the product has now been turned over to Sales. Our future role will be to supply whatever technical service may be needed.

## VI. Development of Silicone Finishes in the Textile Industry

W T ROSSITER
*Manager, Textile and Leather Industry Sales*
*Dow Corning Corp*

### INTRODUCTION

IT is a pleasure to share our trials and tribulations in this complex textile market with you. I would like to discuss the key areas in the development of silicones as a textile finish, and to talk about the type of material, technical and commercial problems involved, the unique prop-

erties as a finish, a market appraisal, method of distribution selected, competitive situation, the merchandising approach developed from a re-look survey, expansion of the market by selective promotion and lastly, but most importantly, the place of market research in our future plans.

## DISCUSSION

The story begins in 1943 with a new material for which it was necessary to find a market. The most basic silicone, dimethylpolysiloxane, is by nature highly water repellent. The first commercial use was as an ignition sealant on military aircraft.

In looking for new markets, it was natural to think of the application of silicones to fabric for water repellency. We were faced immediately with two major types of problems: first, a technical problem where we were unable to cure the fabric at a high-enough temperature to make the silicone durable. We were also unable to make an emulsion that would be easily usable in a mill. The commercial problems were just as staggering: we were a relatively small company with no textile experience, many other technical developments were underway and consuming management's time. Also, the character of the textile industry was different from any we were working with.

Through some excellent chemical research, we were able to produce a silicone that would cure at the normal temperatures used for resin finishing. We did not completely solve the emulsion problem initially, but shipped 100% solid silicone to the plant where emulsions were made and used as needed. Over the next six months, we were able to make some very important observations on the advantages and limitations of our product.

First, fabric of man-made fibers could be made durably water repellent, even to repeated drycleaning. Secondly, the addition of the silicone to normal resins used in synthetic finishing improved tear strength and sewability to a remarkable extent. Also, the feel or hand of the fabric was greatly enhanced; for example, rayon acetate fabric could be made to 'feel' very similar to a woolen.

We also observed the following limitations:

If applied to cotton fabrics and washed above 120° F, the fabric did not retain the silicone finish. This limited our market to a great extent.

Also, on a per-pound basis, silicones were very expensive compared with conventional finishing chemicals.

In view of the uniqueness of this finish, what size market did we envision? At this early phase we noted the following statistics as supplied by U S Dept of Commerce: .942 billion yards of synthetic women's and children's apparel fabric were wet-finished, .198 billion yards of men's and boys' synthetic fabric were finished, and .264 billion yards of synthetic home-furnishings fabrics were wet-finished, for a total of 1.404 billion total yards. This was outside the dimension of a market we felt we could satisfy. The potential cotton market in these same categories totalled 3.67 billion yards. At this early stage of development the vastness of this market dictated additional work. Also, the generally low prices for water-repellent finishes and the distinct possibility of obtaining a substantial sales volume prompted us to price our product on a volume projected on a two-year future date.

Textile chemical companies became interested in our silicone polymer and one company was able to solve the problem of producing a stable emulsion that was easy to ship and to use. This development helped to expand the market much more rapidly. This activity did not go unnoticed by the other basic silicone producers. When they entered the market, they chose to price their raw material competitively and decided not to make and sell emulsions directly, but to sell through textile chemical companies. We, then, decided to re-appraise our position in the market by setting up a survey team early in 1954. This team consisted of our assistant general sales managers, our advertising manager and our market research manager and *me!!!* We talked to converters, mills, fiber producers, finishers, advertising people, department store executives and others with a threefold objective:

1) Increase total sale of our material
2) Protect our present and future business in this industry
3) Establish a foundation for our textile-chemical business.

The findings of our committee were as follows: we had only scratched the surface of this market and we should build recognition of our finish name because we were competing with so many others. To be specific, there were 379 known finishes produced by 134 different companies applicable to 13 different fibers and imparting 31 different basic properties—a formidible task at best.

The action that resulted from the survey and a step to solving our commercial problem was that we established a manager of textile industry sales; engaged an experienced New York textile advertising agency; developed a tag and rigid quality-control program; began advertising on television and even contacted retail buying headquarters of key stores, using our existing sales force. We stepped up technical development to find lower curing emulsions and new types of emulsions that could be applied to other fibers on other equipment; we also increased our market research effort in order to discover other areas where a silicone finish might be useful.

As a result of this, we decided to enter the decorative fabrics field with a heavy promotion of a new brand name rather than our old Dow-Corning finishes name. No finish had been used on upholstery fabric and we consequently opened up a whole new market for our finish. We established a staff of eight sales promotion men who called on manufacturers of garments and furniture and who also set up retail promotions. We extended our new brand name to apparel fabrics as well as decorative fabrics and opened a small emulsion plant and warehouse in Greensboro, NC.

The acceptance of the new brand name was growing very rapidly. We felt that it would be an asset for our chemical company customers to use this name as well as ourselves. We also felt that this would help protect our existing business with chemical companies which represented a good share of our total sales. We also felt that we could help expand the total market for silicone finishes, together with our chemical company customers' specialized technical ability and familiarity with this market.

## CONCLUSION

To summarize our program and the current status:

We enjoy good relationships with our chemical company customers, even though we are in competition with them under our brand name.

We wish to stay in this market on a direct basis so we can improve our older products and be in a position to develop new ones. A recent example is our introduction of the first durable silicone finish for washable cottons. We plan to continue our extensive advertising and merchandising program because we feel we can expand the total market and maintain our fair share in this way. We are extremely interested in again re-evaluating the textile market very carefully. In order to grow, we must place a great deal of emphasis on market research to determine new fields of application with good potential in order to direct technical development, sales and promotion to the most likely productive areas.

*Proceedings of the*

**American Association of Textile Chemists and Colorists**

Copyright, 1959, American Association of Textile Chemists and Colorists

April 6, 1959

37th National Convention———

# DYEING OF ACETATE BLENDS AND ARNEL TRIACETATE BLENDS*

VICTOR S SALVIN
*Head, Dye Laboratory*
*Applications and Product Development Department*
*Celanese Corp of America*

In the increasing trend to use of blends for improved fabric performance as well as styling effects, practical dyeing problems have arisen in such blends as acetate/rayon, acetate/nylon, Arnel/cotton, Arnel/Orlon, Arnel/Dacron. This is particularly the case where a high level of washfastness is required. Not only are difficulties experienced in getting good union shades, but problems arise in obtaining good reserves and clean and bright cross-dyeing effects. In many instances, reduction in light- and washfastness results from excessive staining. The color styling of blends containing both acetate and Arnel are demonstrated.

The practical solution to these problems is based on understanding of the role of each of the dyebath components and of the behavior of the disperse dyes, basic dyes, direct and acid dyes as related to the individual fibers and processing details. Examples are given of specific problems with recommendation for dyehouse processing.

## INTRODUCTION

THE TREND toward the use of blends and combinations of the old and new fibers has brought a challenge to the practical dyer. The fabric engineer has demonstrated that optimum blending of fibers results in properties of improved styling and fabric performance. The converter and the stylist, in their attempt to gain a larger proportion of the consumers' dollar for textiles, have promoted color-styling effects, interesting textures and hands. The emphasis on "wash-and-wear" performance has also brought with it a demand for higher levels of colorfastness by the educated consumer. Cellulose ester fibers, which include secondary acetate and Arnel triacetate, are enjoying increased use as part of this trend. Practically every commercial fiber has been blended with Arnel or with acetate and the dyeing potential of these blends examined for styling effects and colorfastness as well as fabric performance in optimum constructions.

The fiber blends which this paper covers are Arnel/cotton, Arnel/rayon, Arnel/nylon, Arnel/Dacron, Arnel/Orlon, acetate/rayon, acetate/nylon, and Arnel/acetate. The dyeing of these two-fiber and sometimes three-fiber blends has presented a number of interesting problems whose analysis and solution are herewith presented.

## ARNEL TRIACETATE/COTTON

The contribution of Arnel to blends with cotton arises from its high initial modulus, especially in hot-wet condition, which is a contributing factor to the prevention of wrinkles during laundering. Fabrics of Arnel are dimensionally stable and can be durably pleated. Selected dyeing procedures are available for Arnel which give a high degree of light- and washfastness. A large yardage of Arnel/cotton has been marketed and has shown consumer acceptability largely because of styling effects, "wash and wear" fabric performance, hand, and colorfastness.

DYEING OF ARNEL/COTTON IN THE DYEHOUSE FOR SYNTHETICS USING DIRECTS——— Much of the basic information on the dyeing of triacetate/cotton is derived from the traditional knowledge on dyeing of acetate/rayon and acetate/cotton. However, in order to obtain a higher colorfastness and to obtain the desired reserves, several processing steps can be emphasized whether for reserves, unions, or cross dyes.

1) The bleaching of cotton should be under conditions where the Arnel is not saponified. Where saponification does take place, there is some tendency for the cotton dyes to stain the Arnel. For removing motes, a recommended bleach is one using hydrogen peroxide in the presence of small amounts of sodium metasilicate, pH 9.5. The temperature of the bleach bath should not be over 175°F.

2) A selected list of direct dyes which show negligible staining on the Arnel is known. pH of the dyebath should not be above 8.5 since the more alkaline pH's will give some staining of the Arnel with direct dyes.

3) The disperse dyes used for this blend are those of high colorfastness to gas, light, wash and sublimation. CI Disperse Yellow 37 gives no staining on the cotton. A wide variation of staining on the cotton exists among the reds (Table I). The staining of the azo reds on the cotton may be removed by sodium hydrosulfite. In the range of blues, the

**TABLE I**
**Arnel/cotton blends**
**Representative disperse dye staining on cotton**

| 2% dyeing | One gpl Igepon T |
|---|---|
| *Disperse dye* | *Staining* |
| Eastone Brill Fast Pink 2B-GLF | 2–3 |
| CI Disperse Red 35 | 3–4 |
| Genacron Pink B | 3–4 |
| Interchem Acetate Scarlet GSF | 3 |
| CI Disperse Blue 27 | 1–2 |
| Latyl Blue BG | 3 |
| Interchem Acetate Brill Blue NSP | 4 |
| CI Disperse Blue 7 | 3–4 |
| Latyl Yellow YL | 4–5 |
| CI Disperse Yellow 37 | 4–5 |
| Lenra Yellow R | 4–5 |

* Presented at the 37th National Convention in Chicago, Ill, October 30, 1958.

gas-fast blues, such as CI Disperse Blue 27, show staining on the cotton. This staining is not readily removed by sodium hydrosulfite and where good reserves are required an acid bleach may be necessary.

4) Since the stain of disperse dyes on cotton is poor to light, extensive evaluation of various dyebaths, including different types of surfactants and accelerants, was used. The principle employed here is that accelerants might give greater exhaustion of disperse dyes and less available dye for staining. Due consideration was also given the possibility that accelerants might maintain the dye in solution, thereby preventing deposition of crystalline particles upon the surface of the cotton. The same reasoning follows for the use of detergents of high leveling action, such as Parapon AP, a sulfated fatty ester. It is found that these principles hold in that either a) the accelerant dyeing or b) the Parapon AP dyeing show less staining on the cotton for disperse dye than do products which afford wetting action but little leveling action.

5) A number of direct dyes will stain Arnel, and this staining gives poor lightfastness. This occurs from:

a) the use of nonselected direct dyes regardless of dyebaths,
b) selected dyes in an alkaline dyebath, or
c) selected dyes in a nonscouring bath of wetting-out properties only.

The stain is minimized by using selected direct dyes in a neutral bath containing leveling agents such as Tamol N (a neutral sodium salt of a complex condensed aryl organic acid) with Quaker 2700 (Table II).

6) Lightfastness of the blend will be dependent on the selection of disperse dyes, the degree of staining of the disperse dyes on the cotton, the selection of direct dyes and the finishing process. Cationic fixatives, which do not contain copper, used for heavier depths of the direct dyes reduce lightfastness. The type of formaldehyde reactant used for finishing is a major factor. While monomeric urea-formaldehyde is the resin least detrimental to light with selected directs, the hand and certain "wash-wear" fabric properties obtained with ethylene urea-formaldehyde makes it widely used on Arnel/cotton chambray, checks, and irridescent gabardines. These modified urea-formaldehyde resins give lower lightfastness, as shown in Table III. Catalyst used in resin application will also affect lightfastness.

**TABLE II**
**Arnel/cotton blends**
**Some direct dyes of superior lightfastness**

CI Direct Red 89
CI Mordant Blue 1
Fastolite Blue L
Superlitefast Brill Blue 16BLL
CI Direct Blue 76
Calcodur Resin Fast Blue 2G (Pr 612)
Superlitefast Rubine WLKS
CI Direct Red 83
CI Direct Red 84
Superlitefast Yellow EFC (Pr 629)
CI Direct Black 63
CI Direct Green 31
CI Direct Brown 29
CI Direct Red 79
Pyrazol Fast Scarlet RL
Pyrazol Fast Blue FGL
Lumicrease Orange 3LG Pat

**TABLE III**
**Effect of resin finish on lightfastness**
**Arnel/cotton**

| *Dyeing* | *Light 20 hrs* 0.4% CI Disperse Red 35 0.2% Chloran-tine Fast Scarlet BNLL* | *Light 20 hrs* 0.4% CI Disperse Blue 27 0.2% Superlite-fast Brill Blue 16BLL* |
|---|---|---|
| Dyed only | 3–4 | 4 |
| Heatset | 3–4 | 4 |
| Ethylene urea—HCHO $MgCl_2$—catalyst | 2 | 2 |
| Dimethoxymethyl urea—HCHO $MgCl_2$—catalyst | 3+ | 2–3 |
| Urea—HCHO Amine hydrochloride catalyst | 2+ | 2 |
| Urea—HCHO $MgCl_2$—catalyst | 3–4 | 3–4 |

*Shade change, International Gray Scale.

**TABLE IV**
**Procedure for jig dyeings—**
**Arnel/cotton**

1) Hinnekin boil off
   203°F
   35 ypm
   0.5 g/l long-chain alcohol sulfate, such as Trepenol ES

2) Desize
   One g/l crypto anionic, such as Sandopan DTC
   10 g/l sizing agent, such as Rapidase
   Two hrs at 75°C
   Rinse

3) Bleaching—for 50-gallon jig
   Two qts $H_2O_2$ (35%)
   One lb TSPP
   One lb sodium metasilicate
   Two ozs crypto anionic
   45 mins at 80°C
   pH 9.2
   Rinse thoroughly

4) Dyeing—baby blue
   Bath—One g/l sulfated fatty ester, such as Parapon AP
   Dyes—0.2% Superlitefast Brill Blue 16BLL
   0.4% CI Disperse Blue 27
   Time—Dye one hr at 95°C
   Add 10 g/l salt
   Dye two hrs at 95°C
   Rinse—Add five g/l salt to final rinse

5) Drying and heatsetting
   Both pieces dried on Famatex—clips
   Heatset on Morrison cans 405–410°F fabric temp

6) Finishing
   Pad cure with UF resins

7) Heat treatment of the Arnel/cotton blend improves dimensional stability as well as puckering in marginal constructions. Where the Arnel is dyed in heavy shades, washfastness is raised to adequate level.

8) Staining of direct dyes from Arnel, which is due to a slight degree of surface saponification, may be reduced by clearing with one g/l polyvinyl pyrrolidone at 50°-60°C for 20 minutes in presence of salt.

9) Cationic fixatives have some affinity for Arnel as well as secondary acetate when applied by an exhaust method. Where redyeing is necessary, the acid treatment, which is effective in removing cationic fixative from cotton, is not as effective on Arnel. Staining of Arnel is due to mordant action. A thorough scour at pH 9 with two to three g/l of an agent, such as Tamol N, is here recommended.

10) Blacks on Arnel/cotton may be obtained by a combination of Eastman Diazo Navy Blue RB diazotized and developed with phloroglucinol where cotton is to be reserved. In union dyeing, CI Disperse Black 7 diazotized and developed with BONA gives black on Arnel. The black is subjected to the usual heat treatment at 425°F. Fabric is brought back to the dyeing machine for scouring wherein simultaneous removal of the yellow impurities of the black on the Arnel is accomplished while dyeing the cotton with the direct cotton dyes. Either direct dye, such as Cuprofix Black OB or Cuprophenyl Black RL, or CI Direct Black 21 is used with appropriate fixation.

ARNEL/COTTON KNIT FABRICS———Arnel/cotton knit fabrics show improved dimensional stability over 100% cotton knit. The two-fiber blend gives color-styling potential in unions, cross dyes and heathers using conventional one-bath dyeing methods. The blend permits a range of in hand with softer hand desirable in certain applications. Selection of dyes parallels that used for Arnel/cotton woven fabrics as to dyeing principles. Direct dyes are being used for the cotton. Blend of 60% Arnel/40% cotton has been found to be good for general knit application.

The processing for knit follows that used for cotton knit dyeing. The bleach for the blend is a buffered hydrogen peroxide, pH 9-9.5, or sodium chlorite, pH 4, for nonsaponification of Arnel. Small percentage of detergent is used in dyeing. Both disperse and direct dyes are added with dyebath brought to the boil in 20-30 minutes. Salt is added as for

cotton dyeing and dyeing continues to depth and shade. Gradual cooling is essential to avoid creases. Direct dyes are fixed in a new bath with regular cationic fixatives. Cationic softeners can be applied exhaustively before off loading.

The fabrics are dried as cotton knit, ie, in a Tubetex dryer. Minimum pressure on calender rolls should be used.

DYEING OF ARNEL/COTTON USING REACTIVE DYES——The cotton can be dyed with the new types of cellulose-reactive dyes represented by the Procions; their chemically related counter parts, the Cibacrons; and the more recently introduced Remazols. The procedures recommended for application of the reactive dyes either by exhaustion or by padding and thermofixing leave the Arnel essentially unstained. Selection can be made from the available group of Procions and Cibacrons to give a range of shades of good lightfastness without a gas fading change. It is noteworthy that the reactive types of dyes are prone to change by acid chlorine or other oxidation, such as nitrous acid, but the latest additives are much improved in this respect. Service gas fading tests have not shown the active types of dyes to fade. No difficulty has been experienced in the application of the newest types of reactive dyes. The Remazols show nonstaining properties on Arnel as well as light- and washfastness of the same order as Procions and Cibacrons. Some variation of lightfastness with resin type is shown for the reactive dyes and here the monomeric urea-formaldehyde shows less effect on lightfastness than do the cyclic ureas. Selection of catalysts is of advantage with zinc nitrate or magnesium chloride showing less reduction in light.

DYEING OF ARNEL/COTTON USING VAT DYES FOR COTTON ——The dyeing of Arnel/cotton using vat dyes by a continuous process adapted to cotton dyehouse methods has been adequately described in a paper by Ward, Schoeneberg, and Warner (*1*).

Arnel is resistant to saponification of the vat dyebath and especially when heatset. A continuous pad steam process for dyeing of Arnel with disperse color involves a) padding with solution of the dye in 10-20% triethylphosphate in water, b) steaming at 220°F, and c) washing in a continuous unit. In the steaming, disperse dye migrates from cottons to Arnel, thus utilizing dye absorbed in padding on the cotton fiber. The cotton may be dyed by the conventional pad-steam process using vat colors to achieve desired styling effects.

## ACETATE/RAYON AND ARNEL/RAYON

Although the dyeing of acetate/rayon blends is a familiar process, the present-day demand for increased colorfastness to washing makes it worth while to review the levels of wetfastness obtainable in this blend with its high styling potential and adequate performance in certain end uses.

The principles for good wetfastness for acetate have been discussed by Salvin, Conciatori, Ward, Walker and Fortess (*2*). These are:

1) the use of selected dyes of intrinsically high washfastness on acetate. These specific dyes are of the high-temperature, slow-dyeing type and their good washfastness is derived from their slow rate of diffusion into the fiber which also means slow rate of outward diffusion at the lower washing temperatures.

2) The washfastness of these dyes is further improved by reaction with the formaldehyde of resins as well as the combination with copper in the cationic fixative agents used for rayon.

More recently, Eastman Chemical, in offering the Eastofix range, has used the principle of metal fixation for raising the level of washfastness on acetate. The rayon fiber is dyed with fixable directs. Fixation of the rayon dyes is by means of combination of cationic fixative and resins, either urea-formaldehyde or melamine-formaldehyde type.

Of additional interest are the following points:

a) Present-day acetate is more stable to delustering and can be dyed at the higher temperatures needed for the slow-diffusing disperse dyes of higher washfastness.

b) In addition to disperse dyes, the water-soluble dyes, represented by the Solacets and including Celanthrene Fast Blue GSS, are of value. These show a good level of washfastness, low restaining properties in washing and are fixed by cationic fixative and resin.

c) A number of new dyes have been introduced of high intrinsic washfastness of which Latyl Blue BG, Eastone Fast Pink B-GLF, Artisil Direct Scarlet Ultra GFL disperse, and Lenra Yellow R are examples. In heavier shades, where economies are necesary, such resin-fixable dyes as Interchem Acetate Brill Blue NSP are available.

d) Azoic dyeings from diazotization and development on the fiber have been used for acetate, especially for the blacks, navies, and wine shades. This range has been extended by use of diazotizable mono azo bases as Eastman Diazo Navy Blue RB (*4*). This base gives a valuable color range with such developers as $\beta$ oxy napthoic acid (navy), phloroglucinol (black), phenyl methyl pyrazolon (red) (*3*).

e) With consumer education for the need of lower washing temperatures in the newer hydrophobic fibers to avoid setting of creases, lower temperatures in the washing machine and therefore less rigid requirements for colorfastness appear to be the trend. Acetate/rayon dyed and finished for washfastness will give the satisfactory wetfastness at the medium washing machine temperatures.

ARNEL/RAYON——The use of Arnel in combination with rayon affords an opportunity for improved dimensional stability, higher level of wetfastness and pleatability. The use of Arnel with rayon introduces no new principles in dyeing over acetate/rayon. The Arnel is dyed with disperse dyes of good intrinsic washfastness, which also are satisfactory for sublimation in heat treatment. The Solacet type of water-soluble dye is not used since it has little or no affinity for Arnel. The disperse dyes possess a higher level of washfastness on Arnel (*3*).

## ARNEL/DACRON

Arnel/Dacron presents the problem of two hydrophobic fibers being dyed with the same type of dye, ie, disperse dyes. The dyes have varying dyeing rates and affinities for the respective fibers. The dyeing system requires use of carrier for practical dyeing times on the Dacron fiber. The kinetic data show that it is not possible to speak of Arnel as a more rapidly dyeing fiber than Dacron. It is necessary to specify the dyestuff and the conditions. The following

**TABLE V**
**Distribution of 2% dye — Arnel/Dacron**
**Methyl salicylate carrier. Dyed 95°C — two hours**

| Dye | Fiber preference | Approx ratio | Wash | | Light | |
|---|---|---|---|---|---|---|
| | | | Arnel | Dacron | Arnel | Dacron |
| Latyl Blue BG | Arnel | 5–4 | good | good | good | good |
| CI Disperse Blue 27 | Arnel | 3–2 | good | good | good | good |
| Latyl Blue 4R | Dacron | 4–1 | fair | fair | fair | poor |
| CI Disperse Blue 9 | Arnel | 3–1 | good | good | good | poor |
| Latyl Violet BN | Dacron | 4–1 | fair | good | fair | fair |
| Eastman Polyester Scarlet RGLF | Arnel | 5–1 | good | good | good | fair |
| Eastman Polyester Dark Red FL | Arnel | 3–2 | fair | fair | fair | fair |
| Latyl Cerise B | Dacron | 3–2 | poor | good | good | good |
| Latyl Red B | Dacron | 3–1 | poor | good | good | good |
| Artisil Direct Orange GLF | Arnel | 3–2 | fair | fair | fair | fair |
| CI Disperse Yellow 37 | Arnel | 4–1 | good | good | good | good |
| CI Disperse Yellow 23 | Dacron | 3–2 | poor | fair | good | good |
| Eastman Polyester Yellow RL | Arnel | 5–4 | fair | good | fair | fair |

**TABLE VI**
**Carrier specificity**

Distribution of dye—Arnel/Dacron
Tertiary shade — 2% CI Disperse Blue 27, 1% Eastman Polyester Dark Red FL, 1% Artisil Direct Orange GFL ultradispersed
Two hrs—95°C
Liquor ratio 30–1 — 3.0 g/l carrier

| Carrier | Relative Depth Arnel | Dacron | Tone |
|---|---|---|---|
| None | 5 | 1 | on tone |
| Tripropyl phosphate | 6 | 1 | cross dye |
| Butyl benzoate | 4 | 1 | fair tone |
| Methyl salicylate | 3 | 2 | on tone |
| Phenyl salicylate | 4 | 3 | on tone |
| Biphenyl | 5 | 4 | on tone |
| Trichlorobenzene | 4 | 3 | on tone |
| Orthophenylphenol | 3 | 2 | Dacron bluer |
| Dimethyl terephthalate benzanilid | 3 | 2 | on tone |

were found to be critical factors affecting dye distribution between the two fibers:

1) Specific behavior of the dye
2) Temperature
3) Accelerant type and concentration
4) Fiber ratio
5) Dye concentration
6) Effect of interaction of dyes.

The range of disperse dyes including those disperse dyes marketed under the Latyl, Eastman Polyester, Polydye, Resoline, Amacron, and Genacron designations were examined to show specific behavior of the dye with respect to distribution. Distribution data was obtained by codyeing the two fabrics for two hours at 95°C using five g/l of a methyl salicylate-based carrier at a liquor ratio of 30-1. Visual evaluations are listed in Table V. Of particular interest are the findings that a) certain dyes favor Arnel whereas other disperse dyes favor Dacron, and b) a limited group of dyes show encouraging distribution in a 3-2 ratio favoring Arnel. Since the Arnel/Dacron blends have end use in "wash-and-wear" performance, good washfastness is essential. Certain of the dyes suitable for Dacron, such as Latyl Cerise B and CI Disperse Yellow 23, do not have as good a level of washfastness on Arnel and were not further considered.

Of the dyes showing properties of reasonably good washfastness and sublimation fastness, the following possessed favorable distribution:

CI Disperse Blue 27
Latyl Blue BG
Eastman Polyester Dark Red FL
Eastman Polyester Yellow RL
Artisil Direct Orange GFL ultradispersed.

Although the use of dye mixtures was considered, it was felt that a one-bath dyeing procedure using dyes with close to union dyeing properties would meet the practical objective.

The next step in attack on the problem was the determination of whether accelerants were specific in their action as are the dyes. To this end a tertiary shade in a critical brown using 2% CI Disperse Blue 27, 1% Eastman Polyester Dark Red FL, and 1% of Artisil Direct Orange GFL ultradispersed was dyed on a 50/50 Arnel/Dacron blend fabric under conditions of three g/l carrier 95°C for two hours at 30:1 liquor ratio. (Table VI.)

A group of carriers were examined using the dye group established as having close to union dyeing. The objective was to determine whether a carrier specificity could be found. Although such accelerants as tripropyl phosphate and butyl benzoate favor Arnel, no accelerants were found which favored the polyester fiber. Table VI shows that phenyl salicylate, methyl salicylate, orthophenylphenol, biphenyl, trichlorobenzene and dimethyl terephthalate benzanilid accelerate both fibers. However, there is some superiority for phenyl salicylate in its balanced effect on the three dyes used in combination. It is effective on either 50/50 Arnel/Dacron or on 70/30 Arnel/Dacron.

The use of specific carriers and selected dyes of balanced distribution between the two fibers is the basis of a dyeing system which gives a union-appearing fabric. The fibers are essentially tone-on-tone in critical grey and tan shades with Dacron slightly lighter and bluer in shade. Heat treatment improves the union appearance. 20 to 40 hours lightfastness and 140°F washfastness were obtained in experimental runs. The process gives best results with intimate blends. Where fabric construction permits, jig dyeing reduces the cost of accelerant.

Distribution of CI Disperse Blue 27 in the range 200 to 260°F between the two fibers suggests that a group of dyes with balanced dyeing properties could be found at 220 to 230°C. These data would be applicable to beam dyeing under pressure with no accelerant present in the dyeing system.

The principles established on Arnel-Dacron 5400 are being applied to current studies on more readily dyeable Dacron 5400 and Kodel.

## ARNEL/NYLON AND ACETATE/NYLON

The addition of nylon to acetate or Arnel has as its main function improvement of strength and resistance to abrasion. The problems in dyeing arise from the fact that the disperse dyes used for Arnel or acetate have excellent affinity for nylon. Disperse dyes not only give variable distribution between the two fibers but also may have different shades; thus most azo reds are noticeably bluer on nylon and blues are greener. In addition to the problems of uniform shade and depth on two fibers, the problem of colorfastness exists. Disperse dyes, in most cases, show poorer washfastness and poorer lightfastness on nylon. Although nylon can be reserved to acid dyes by means of resist agents, there are no known methods by which nylon can be made to resist the affinity for disperse dyes.

The problem of dyeing nylon and reserving the acetate fiber is readily solved by choice of acid or premetalized dyes. A selection of acid dyes is available which will dye the nylon in a full range of depths leaving the acetate or Arnel essentially unstained. This list includes both the premetalized dyes and the acid dyes. Critical selection must be made in the navies and blacks. Where washfastness of the nylon is essential,

**TABLE VII**
**Dyeing properties of disperse dyes**
**Acetate/nylon**

| Group | Dyestuff | Level dyeing | Resistance to gas fading | Lightfastness |
|---|---|---|---|---|
| Blues | CI Disperse Blue 27 | poor | high | high |
| | Latyl Blue BG | fair | high | high |
| | Artisil Direct Blue GFL | good | high | high |
| Yellows | CI Disperse Yellow 37 | poor | high | high |
| | Lenra Yellow R | poor | high | high |
| | CI Disperse Yellow 33 | good | high | high |
| | CI Disperse Yellow 2 | good | high | high |
| | CI Disperse Yellow 34 | fair | high | high |
| Reds | CI Disperse Red 35 | poor | high | high |
| | Eastone Fast Scarlet R-GLF | poor | high | high |
| | CI Disperse Red 5 | poor | high | fair |
| | CI Disperse Red 9 | good | high | good |
| | Latyl Cerise B | good | sl change | high |
| | CI Disperse Red 11 | good | marked change | high |
| | CI Disperse Red 4 | good | sl change | high |
| | CI Disperse Red 15 | good | marked change | high |

aftertreatment with tartar emetic serves to give a good level of washfastness.

The dyeing of acetate/nylon carpets represents a good illustration of the use of selected dyes in achieving the union-dyeing appearance and the high lightfastness required for this end use. Table VII gives the distribution of disperse dyes between acetate and nylon with evaluation of their dyeing properties and fastness properties. The union-dyeing properties are also indicated. In the light shades, which comprise the great majority of carpet shades, colorfastness to light is demanded. It is also necessary to have reasonably good unions between the acetate and nylon, since marked difference in fiber colors will show up in wear tests. Dyes are also selected which do not give acid-base change in alkaline shampooing. Resistance to change by atmospheric fading is essential.

Gas-fast blues are represented by CI Disperse Blue 27, Latyl Blue BG and Artisil Blue GFL ultra dispersed. The Artisil Blue GFL ultra dispersed gives best leveling properties. CI Disperse Blue 27 has only moderate lightfastness on nylon. Latyl Blue BG, because of its slow strike, builds up to a better union on the blend. Where nylon is present in 20 to 30% ratio, the use of a dye with high lightfastness on the acetate compensates for its lower lightfastness on nylon.

CI Disperse Red 4, CI Disperse Red 9, Latyl Cerise B, and CI Disperse Red 15 give good union dyeing as well as leveling properties. Problems in shade variation between acetate and nylon are not as pronounced as in azoic reds, ie, CI Disperse Red 35. Although CI Disperse Yellow 3 has excellent lightfastness on nylon, it has poor lightfastness on acetate. CI Disperse Yellow 23 suffers acid base change. The yellows of good lightfastness are of diphenyl amine structure, eg, CI Disperse Yellow 2, CI Disperse Yellow 33, and CI Disperse Yellow 37. They favor acetate, leaving nylon only lightly dyed. Formulations based on Latyl Blue BG, CI Disperse Red 9, and CI Disperse Yellow 37 were found to give desired combination of lightfastness and atmospheric fading while retaining union dyeing. In certain shades, it is necessary to add a yellow from the neutral-dyeing premetalized group, such as Cibalan Yellow RL, to shade over the nylon.

The formulations used for obtaining high lightfastness (60 hours minimum) on the carpet fabrics point up the fact that a selected list of disperse dyes of high lightfastness on acetate exists. Lightfastness is dependent on texture of the fabric, with carpets and raised effects in upholstery fabrics showing less recognizable change than flat fabrics. Lightfastness is significantly higher on bright yarn than dull yarn. The recipes used in problems of lightfastness are balanced with respect to fade and illustrate the principle that specific formulation must be worked out for each particular shade for best results.

ARNEL/NYLON AND ARNEL/NYLON/RAYON———In the case of these blends containing Arnel, the problems of union dyeing are further complicated by the requirement of good wetfastness. Color performance is directly related to the distribution of disperse dye between the Arnel and the nylon. The conditions of high dyeing temperature, longer dyeing time and use of accelerant favor increased exhaustion onto the Arnel at the expense of the nylon. Disperse dyes used are from the group of good washfastness on Arnel. For union dyeing, neutral (metalized) dyes may be used to tone up the nylon. Scouring after dyeing serves to remove loose disperse dye on the nylon thereby improving the wetfastness.

Where resins are used, especially in presence of rayon, the resin will improve washfastness of the direct dye on rayon as well as the disperse dye on nylon.

A one-bath dyeing method using combination of disperse dyes, premetalized dyes and direct dyes is employed for dyeing Arnel/nylon viscose blends. Selection of dyes and high dyeing temperatures permit dyeing on the winch without use of accelerant. Presence of accelerants in winch dyeing tends to give winch creases in certain constructions.

## ARNEL/ORLON

Arnel/Orlon blends are finding considerable interest, particularly in knit wear. Arnel contributes improved pilling resistance, color styling, and economics; also excellent shape retention and pleatability. Blends can be dyed to unions, heathers and reserves. The range of shades have lightfastness of 20-40 hours and acceptable washfastness at 120-140°F.

The dyeing for reserve effects is best accomplished by dyeing the Orlon with cationic dyes. Selection of cationic dyes must be made since variable degree of staining is shown on Arnel. Table VIII lists the degree of staining of a representative group of dyes. The stain of the cationic dye is cleared by means of an acid hypochlorite, two cc/l sodium hypochlorite (5% solution) and 0.5 cc/l HCl for 10-20 minutes at 25°C. The fabric is antichlored and rinsed. The stain of the cationic dyes is generally poor to light and washing.

Although disperse dyes have sig-

**TABLE VIII**
**Dyeing properties of cationic dyes**
**Arnel/Orlon blends**

| Dye | Arnel staining | pH range in dyeing |
|---|---|---|
| CI Basic Yellow 11 | slight | 6-8 |
| CI Basic Orange 21 | light | 6-8 |
| Sevron Orange G | light | 4.5-8 |
| Sevron Orange L | moderate | 6-8 |
| CI Basic Red 14 | slight | 4.5-8 |
| Sevron Brilliant Red B | light | 4.5-7 |
| Sevron Red L | light to moderate | 6-8 |
| CI Basic Blue 21 | slight | 4.5-8 |
| Sevron Blue 5G | light | 4.5-6 |
| Deorlene Blue 5G | light | 4.5-6 |
| CI Basic Green 4 | moderate | 4.5-5.5 |
| CI Basic Violet 14 | moderate | 4.5-5.5 |

nificant affinity for Orlon and will buildup to light and medium shades on 100% Orlon, distribution in the Arnel/Orlon blend favors the Arnel to a high degree. The Orlon is stained very slightly to moderately, depending on the concentration of disperse dye present. Colorfastness of the disperse dye on Orlon is high.

Dyeing for union and cross dyeing is possible by use of combination of disperse and cationic dyes. Initially, a two-bath system was used wherein the Orlon was first dyed with cationic dyes at pH 4.5 to 5.0 and the Arnel then dyed in a new bath with disperse dyes. The staining of cationic dyes on Arnel and disperse dyes on Orlon made shade matching difficult. The two-bath process is lengthy and economies were desired. A one-bath process had been limited to pastel shades because of coprecipitation of dyes and dyebath components due to interaction of cationic dye with anionic surfactant or disperse dyes containing polar groups.

No information was available as to why incompatible dyebaths form. Preliminary work established:

1) The dispersing agents used in disperse dye powders, ie, lignin sulfonic acid or alkyl aryl sulfonates, did not precipitate dyebaths containing typical basic dyes such as CI Basic Red 14 or CI Basic Green 4.

2) When disperse dyes as oil colors are placed in dye solution containing basic colors at the boil, a precipitate is formed. The basic dyes used were Sevron Red L, Sevron Orange L, Sevron Blue 5G and CI Basic Red 14 whereas the disperse dyes were CI Disperse Yellow 37, CI Disperse Blue 27, and Eastone Brill Fast Red 2B-GLF.

3) Of a group of surfactants added to combinations of disperse and cationic dyes, specific materials, such as Igepon T, Tamol N, and Parapon AP in quantity of 0.5 g/l prevented precipitation of dye.

4) Stability of dyebaths appeared better at more neutral pHs with disperse dyes showing more duplicable exhaustion rates.

5) Increase in amount of dispersing agent, such as Tamol N and Parapon AP, caused marked reduction in exhaustion of basic dyes.

On the basis of these observations, a one-bath dyeing process was developed, giving stable dyebaths for light-medium and medium-full shades. The process uses cationic dyes which exhaust well at more neutral pHs of 6.0-6.5. The surfactant used was Igepon T. The disperse dyes are those recommended for Arnel as of good all-around fastness.

Disperse and basic dyes are not compatible in concentrated solutions. Each dye class must be separately dissolved and well diluted before addition to dyebath. Basic dye is added first.

Retarders should not be present since they cause instability and tarring of the dyebath. Glauber's salt has no effect.

For darker shades, a two-bath method is recommended. The basic dyes used for lower costs are not compatible with disperse dyes and especially at the higher concentrations.

The experimental results in Table IX present the following dyeing mechanism for a stable one-bath system. Cationic dye will coprecipitate with disperse dyes. The addition of selected anionic surfactants results in a salt formation with the cationic dyes; whereupon the basic group is neutralized and not available for complex formation with the disperse dye. The anionic surfactant must give a salt which is at least sparingly soluble in the dyebath. At the dyeing temperature 95-100°C, there is sufficient hydrolysis of the combination to permit exhaustion onto the Orlon.

Table X represents a typical procedure for the union dyeing of Arnel/Orlon knit fabric.

**TABLE IX**
**Stability of cationic — disperse dyes**
**pH 6.0 — 6.5**

| Surfactant | Dye | Stability |
|---|---|---|
| Tamol N—sodium salt of sulfonated naphthalene formaldehyde condensate | CI Basic Red 14 | stable |
| Marasperse N—sodium lignosulfonate | Sevron Blue 5G | stable |
| None | CI Basic Red 14<br>Eastone Fast Pink B-GLF | breaks |
| Emulphor ELA | CI Basic Red 14<br>Eastone Fast Pink B-GLF | breaks |
| Alkanol HCS — nonionic surfactant | CI Disperse Blue 27<br>CI Basic Blue 22 | breaks |
| Igepon T (1% owf) | CI Basic Red 14<br>Eastone Fast Pink B-GLF | stable |
| Igepon T (1% owf) | CI Disperse Blue 27<br>CI Basic Blue 22 | stable |

**TABLE X**
**One-bath procedure for union dyeing Arnel/Orlon knit fabrics**

Dyebath—....% disperse dye
....% cationic dye
0.50% Igepon T Gel
0.13% acetic acid
0.10% sodium acetate
liquor ratio 30–1

DYEING PROCEDURE

1) Scour 20 minutes at 160°F with 2.0% nonionic surfactant and 1.0% TSPP. Rinse well.
2) In a new bath at 90–100°F. add cationic dyes and dye assistants. pH 6.0. Run five minutes.
3) Add dissolved disperse dyes. Run five minutes.
4) Raise temperature slowly to 190°F over 30 minutes.
5) Raise temperature from 190°F to 208–212°F over 30 minutes.
6) Run 90 minutes at 208–212°F. Sample.
7) Cool back to 180°F before making adds.
8) When on shade, open doors to the machine and cool bath down slowly to 160°F by radiation.
9) Gradually cool bath down and rinse by overflowing with warm and cold water.
10) Scour goods 15–20 minutes at 120°F with 1.0% nonionic surfactant.
11) Apply in final rinse bath at 120°F for 20 minutes 2–4% cationic softener.

**TABLE XI**
**Disperse dyes**
**Ratio of depth of shade — Arnel vs acetate**

| | Temperature type | Shade depth Acetate | Arnel |
|---|---|---|---|
| CI Disperse Blue 27 | high | 75 | 25 |
| CI Disperse Blue 9 | high | 75 | 25 |
| CI Disperse Blue 7 | high | 80 | 20 |
| CI Disperse Blue 3 | medium | 65 | 35 |
| CI Disperse Blue 1 | medium | 65 | 35 |
| CI Disperse Red 35 | high | 75 | 25 |
| CI Disperse Red 17 | medium | 60 | 40 |
| CI Disperse Red 15 | low | 50 | 50 |
| CI Disperse Red 13 | medium | 70 | 30 |
| CI Disperse Yellow 37 | high | 80 | 20 |
| CI Disperse Yellow 33 | low | 50 | 50 |
| CI Disperse Yellow 3 | low | 50 | 50 |
| Lenra Yellow R | high | 75 | 25 |

## ARNEL/ACETATE AND ARNEL/ACETATE/RAYON

Color-styling effects represent a large part of the sales appeal of blends. This has been true particularly of acetate and rayon, which have great versatility in combinations because of their dyeability to reserves, union and cross dyes. The addition of Arnel to this blend offers an additional dimension in styling to give multicolor effects. Styling effects are possible on Arnel/acetate because of their distinct differences in dyeing behavior. The color differences are based on the following principles, as illustrated in Table XI and XII:

a) The difference in dyeing rate between Arnel and acetate using selected disperse dyes gives a distribution favorable to acetate and results in tone-on-tone effects.

b) By the use of certain water-soluble dyes, which have affinity for acetate and little or no affinity for Arnel, marked differences in depth approaching reserve on the Arnel are possible.

c) By the use of combinations of disperse and water-soluble dyes, related shades are readily obtained on the Arnel/acetate combination.

d) With a third fiber present, dye-

able with directs as rayon or cotton, reserve or contrasting shades are possible to give multicolor styling effects. Representative shades and recipes are given in Table XIII.

The dyeing process is an economical one-bath dyeing process. Plant trials have demonstrated duplicability in shade matching. The same level of colorfastness can be achieved on combination fabrics as is normally obtained on 100% acetate and acetate/rayon fabrics for drycleaning applications. Improvement in washfastness to medium temperature washing machine level requires specific dye selection and fixation treatments.

The high-temperature dyes have slower dyeing rate on Arnel and distribution approximates 75-25. This ratio holds with variation of dyeing temperature, liquor ratio, time and detergent. Tertiary shades, ie, brown and grey, build up in tone. Dye adds are possible for matching.

Low-temperature dyes in reds and yellows give close unions. No disperse blues however are known which give unions, although addition of carrier helps. Union black is obtainable by standard azoic procedures using developed methods.

The water-soluble dyes contain sulfonic or sulfato groups. These dyes, which require salt in dyebath, reserve Arnel in case of the blue Celanthrene Fast Blue GSS and dye Arnel only slightly in case of the Solacet reds and yellows. The staining on the rayon is removed by soaping to give satisfactory reserves. Higher temperatures of 85°C are required for build up of water-soluble dyes. Short liquor ratios and low surfactant quantities give best exhaustion.

**TABLE XII**
**Water-soluble dyes**
**Ratio of depth of shade — Arnel vs acetate**

| | Shade depth | | |
|---|---|---|---|
| | Acetate | Arnel | Rayon stain |
| CI Acid Blue 14 | 100 | stain | RAS |
| Celanthrene Fast Blue GSS | 100 | stain | RAS |
| Solacet Blue WBK | 95 | 5 | RAS |
| CI Acid Orange 64 | 90 | 10 | stain |
| CI Acid Red 159 | 90 | 10 | stain* |
| CI Acid Red 53 | 90 | 10 | stain* |
| CI Acid Yellow 65 | 90 | 10 | RAS |
| Solacet WGRS | 90 | 10 | RAS |
| Solacet WRS | 90 | 10 | sl stain |

RAS—Reserve after scouring
*—Cleared with cold hydrosulfite

**TABLE XIII**
**Recipes for shade range for Arnel and acetate**
**Tone on tone**

| Recipe | Acetate | Arnel |
|---|---|---|
| 2.0% CI Disperse Yellow 37<br>0.5% CI Disperse Red 35 | full orange | lt yellow |
| 1.0% CI Disperse Blue 3<br>0.5% CI Disperse Yellow 37<br>0.45% CI Disperse Red 35 | charcoal | lt grey |
| 0.85% CI Disperse Blue 27<br>1.25% CI Disperse Yellow 37<br>0.5% CI Disperse Red 35 | Cuban coffee | lt brown |
| *RELATED SHADES* | | |
| 1.0% CI Disperse Yellow 37<br>0.5% Celanthrene Fast Blue GSS | green | yellow |
| 1.0% CI Disperse Yellow 37<br>3.0% Celanthrene Fast Blue GSS<br>1.0% CI Acid Red 53 | navy | orange-yellow |
| 0.5% CI Disperse Red 35<br>0.5% Solacet Yellow WGRS<br>0.5% Celanthrene Fast Blue GSS | medium tan | pink |
| 0.5% CI Disperse Blue 27<br>1.0% Solacet Yellow WGRS<br>0.2% CI Acid Red 159 | olive | lt blue |

The rayon dyes are standard fixable rayon dyes.

All combinations of tone on tone using disperse dyes are possible. Dyes of balanced behavior are used for tertiary shades of black, brown, and charcoal. In related shades, the combination of high-temperature dyes and water-soluble dyes is recommended. The shade on the Arnel will always be a component of the shade on the acetate.

The multicolor effects are most readily shown in plaids, stripes, checks, as well as in combination fabrics designed for iridescent effects. Variation in the dye combinations can give changes in apparent design of the fabric.

## SUMMARY

The problems of the dyeing of blends of acetate fibers including Arnel triacetate have been analyzed in terms of a) kinetics of dyeing, b) behavior of dyebath components, c) colorfastness, and d) specific properties of individual dyes. These principles have been applied in the processes developed for dyeing of blends with cellulosics, cotton and rayon, and the hydrophobics, nylon, Dacron and Orlon.

## ACKNOWLEDGMENT

Acknowledgment is made to R G Stoll and Fred Fortess for guidance in this work and to T W Westarp, G W Rigley, R E Lacy, D H Hellman, F J Porter, and J R Adams, who have contributed technical data.

## LITERATURE CITED

(1) Schoeneberg, Ward and Warner, "Processing of Arnel/Cotton Blends by Cotton Dyehouse Procedures," *Am Dyestuff Reptr* **47**, P655 (1958).
(2) Salvin, Conciatori, Ward, Walker and Fortess, "Improved Washfastness of Acetate/Rayon Blends," *ibid* **43**, P764 (1954).
(3) "Dyeing, Printing, Finishing and Heat Treatment of Arnel," Celanese Corporation of America, Technical Bulletin TD 15A.
(4) Carmichael, D — Private Communication, Eastman.

# AATCC Calendar

**COUNCIL, COUNCIL COMMITTEES, RESEARCH COMMITTEES**

May 29, 1959 (Mount Royal Hotel, Montreal, Canada) AM-Council meeting; PM-Joint luncheon and technical session with CATCC

**NATIONAL CONVENTIONS**

Oct 8-10, 1959 (Sheraton Park and Shoreham Hotels, Washington, DC); Oct 6-8, 1960 (Sheraton Hotel, Philadelphia, Pa.); September 28-30, 1961 (Buffalo, NY); 1962 (Southern Region)

**DELAWARE VALLEY SECTION**

Apr 11 (Ladies Night—Kugler's); May 22 (Annual Outing—Philmont Country Club, Huntingdon Valley, Pa)

**HUDSON-MOHAWK SECTION**

May 22 (Ladies night, Schuyler Meadow Country Club, Albany, NY); June 26 (Annual outing—Antlers Country Club, Amsterdam, NY)

**METROPOLITAN SECTION**

Apr 10, May 15 (Kohler's Swiss Chalet, Rochelle Park, NJ); June 19 (Outing)

**MID-WEST SECTION**

April 25 (Schroeder Hotel, Milwaukee, Wis); June 12-13 (Outing—Brown Lake Resort, Burlington, Wis); Oct 24 (Bismarck Hotel, Chicago, Ill)

**NORTHERN NEW ENGLAND SECTION**

May 15 (Joint meeting with LTI Student Chapter, Lowell Technological Inst, Lowell, Mass); Sept 18 (Outing—Wachusett Country Club, West Boylston, Mass); Oct 16 (Lexington Inn, Lexington, Mass); Dec 4 (Joint symposium with ASME Textile Engineering Div, Smith House, Cambridge, Mass); Jan 15 (Woodlawn Golf Club, Newton, Mass)

**PIEDMONT SECTION**

April 10-11 (Robert E Lee Hotel, Winston-Salem, NC); June 5-7 (Outing—Grove Park Inn, Asheville, NC); Sept 25-26 (Barringer Hotel, Charlotte, NC)

**RHODE ISLAND SECTION**

Apr 24 (Student Night); June 12 (26th Annual Outing, Metacomet CC); Sept 18 (Management Night); Oct 23 (Prov Eng Soc, Providence, RI); Dec 4 (Annual Meeting—Johnson's Hummocks Grille, Providence, RI)

**SOUTH CENTRAL SECTION**

Sept 19 (Hotel Patten, Chattanooga, Tenn); June 26-27 (Outing—Riverside Hotel, Gatlinburg, Tenn)

**SOUTHEASTERN SECTION**

April 18 (National Guard Armory, Cedartown, Ga); June 12-14 (Summer Outing—Radium Springs, Ga); Sept 12 (Ida Cason Callaway Gardens, Pine Mtn, Ga); Dec 5 (Atlanta Athletic Club, Atlanta, Ga)

**WESTERN NEW ENGLAND SECTION**

Apr 17 (Rapp's Restaurant, Shelton, Conn); May 15 (Ladies' Night—Rapp's Paradise Inn, Ansonia, Conn); June 12 (Outing—Wallingford, Conn); Sept 25 (Blake's Restaurant, Springfield, Mass); Oct 23 (Annual Meeting—Rapp's Restaurant, Shelton, Conn); Dec 4 (Hartford, Conn)

37th National Convention———

# EVALUATION OF THE CELANESE WRINKLE TESTER*

ERNEST R KASWELL[1]
*Fabric Research Laboratories, Inc*
*Dedham, Mass*

The AATCC Committee for the Evaluation of Creasing Properties of Fabrics conducted an interlaboratory evaluation study of the Stoll-Celanese Wrinkle Tester.

Three pairs of fabrics, each consisting of an untreated control and a resin-finished sample, were evaluated by 14 observers from seven laboratories. Excellent correlation was found among observers' ability to rank the fabrics for wrinkle resistance.

Comparisons were made between the Stoll-Celanese test results and the Monsanto Crease Angle, Cyanamid Crease Angle, and the Hebeler-Kolb Profile Height Wrinkle tests. Good correlation was found to exist among all tests, with the exception of the Hebeler-Kolb.

Since the Stoll-Celanese test employs a subjective rather than objective evaluation, the AATCC Committee voted not to recommend it as a standard test method. A challenging problem is the conversion of the five subjective wrinkle-resistance criteria into objective physical measurements. By such an accomplishment the test might be quantified and become more useful.

The Stoll-Celanese evaluation method may also be of value in similar evaluations of "wash-and-wear" fabrics.

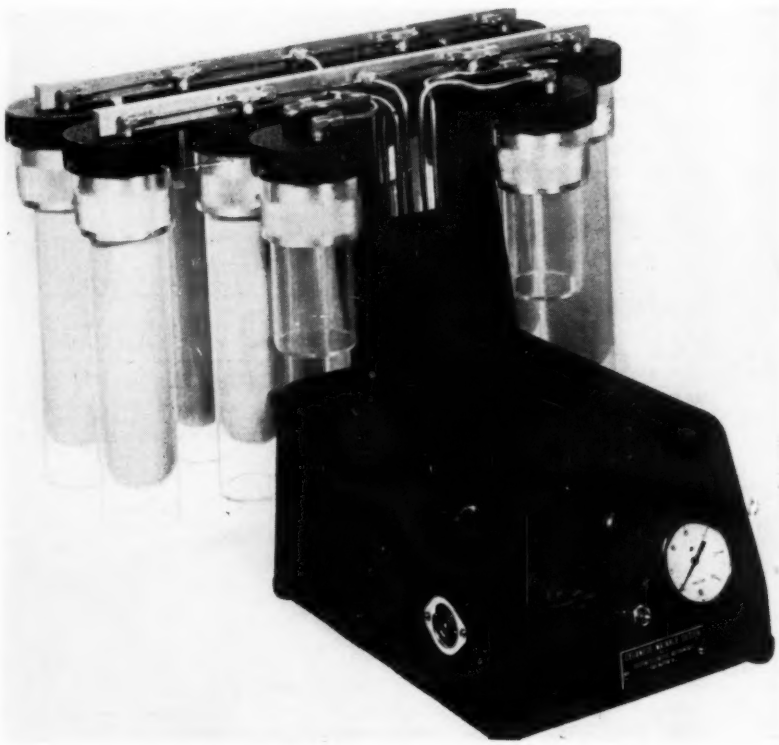
## INTRODUCTION

THE AATCC Committee for the Evaluation of Creasing Properties of Fabrics has been cognizant of the importance of developing proper test methods for the measurement of wrinkle resistance and crease retention. Currently, both the Monsanto and Cyanamid crease-angle-recovery tests are listed as approved test methods in the *AATCC Technical Manual.* Undoubtedly, because of its lower cost, the Monsanto Tester enjoys more widespread use in the United States. Briefly, the test consists of creasing a 4.0 x 1.5-cm specimen under a 1.5-lb dead load for five minutes, removing the load and allowing recovery for five minutes, and then reading the recovery angle. The Cyanamid test is basically the same.

While these tests have proved to be of great value in judging wrinkle resistance, particularly for quality control, it will be apparent that they are arbitrary, and to an extent artificial. In use, fabrics are certainly not creased under specific conditions of direction, load, and time. Rather, wrinkling is a random application of compressive loads applied to fabric folds in certain areas of a garment. The evaluation of amount of wrinkling, or lack thereof, is the subjective opinion of observers who employ visual means for rating the merits of a fabric. As is the case for evaluating many textile properties, eg, drape, handle, luster, the problem of relating subjective reaction and qualitative estimates of wrinkle resistance with quantitative objective measurement is difficult if not impossible. Subjective reactions vary from person to person; tactile and visual properties are in most cases the interaction of several quantitative properties; furthermore, tactile and visual criteria are ever changing, depending upon the end use to which the textile is put. Thus the textile technologist often faces the dilemma of utilizing either a quantitative objective test, which is artificial and not representative of actual service, or a subjective qualitative test, which more nearly depicts service performance but which is impossible to quantify.

Because the Monsanto-type test was felt not necessarily to reproduce actual service conditions, and because the AATCC Creasing Properties Committee was alert to the necessity for evaluating other "wrinkle testers," a study was made of the potential use of the Celanese Wrinkle Tester developed by Reiner G Stoll. This instrument wrinkles 8″ x 8″ fabric samples in a random but reasonably uniform manner. The wrinkled fabrics are then subjectively ranked by five qualitative subjective visual criteria, and a weighted numerical index of wrinkle resistance is calculated.

Figure 1
Celanese Wrinkle Tester



* Presented during the 37th National Convention on October 31, 1958 at the Conrad Hilton Hotel, Chicago, Ill.
[1] Chairman, AATCC Committee for the Evaluation of Creasing Properties of Fabrics.

## DESCRIPTION OF THE CELANESE WRINKLE TESTER

Figure 1 is a photograph of a Celanese Tester capable of wrinkling 10 specimens at one time. Figure 2 is a schematic diagram of one of the chambers where the wrinkling takes place. One edge of fabric Sample A is carefully wrapped around flange B of sealed cover C. The sample thus assumes the shape of a cylinder at the start of the test. A rubber diaphragm D is then drawn up completely over the sample. A clear plastic cylinder E envelopes the fabric and rubber diaphragm assembly. Plunger F, actuated by Spring G, presses against the rubber diaphragm.

At the start of the test, air is evacuated from the diaphragm, causing it to collapse, thereby randomly wrinkling the test specimen. Plunger F pushes against the collapsed rubber diaphragm, thereby adding to the compression and wrinkling of the sample. At the end of two minutes, air is pumped into the diaphragm, pushing the plunger back out and permitting the fabric to expand and recover. After two minutes of recovery the process is repeated. Eight (or more) such compression-relaxation cycles are applied to each fabric during the test. The fabric is then *carefully* removed from the diaphragm, attached to clipboards which are then carefully placed in a specially constructed viewing box (Figure 3) for wrinkling evaluation. The viewing box contains two fluorescent lights below a frosted pane of glass. The clipboards are laid on a frame at an angle of 120° to the plane of the glass. By this reproducible technique, all samples are uniformly lighted at the same angle. It has been found that the 120° angle gives both surface and edge lighting, thus permitting critical viewing of wrinkled areas.

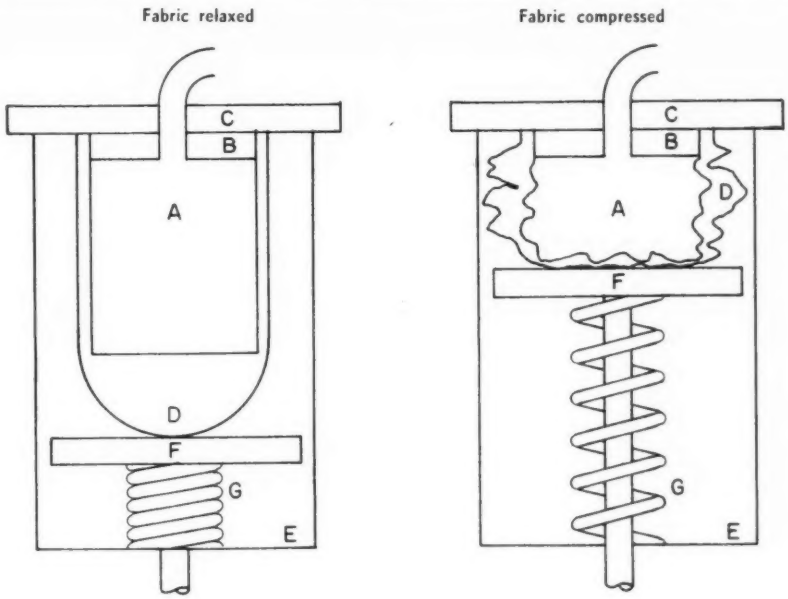



Figure 2
Schematic diagram of Celanese Wrinkle Tester

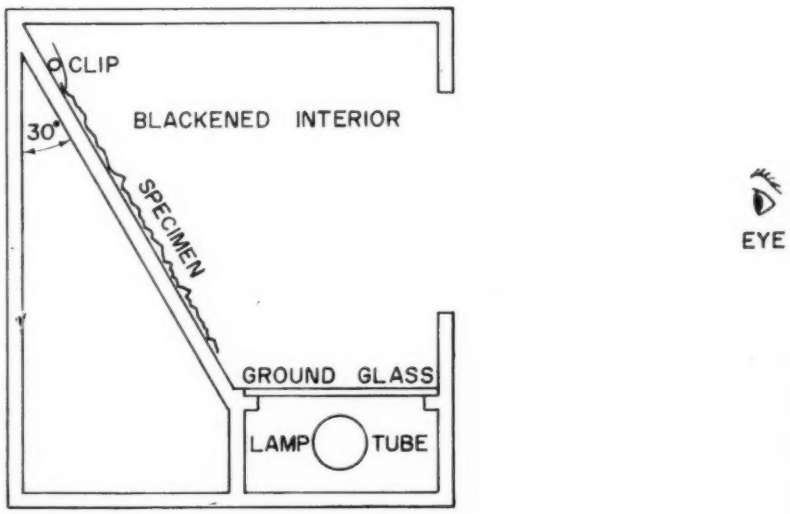



Figure 3
Schematic diagram of viewing box for wrinkled-sample evaluation

## EXPERIMENTAL PROCEDURE

Three pairs of fabrics, each consisting of an untreated control and a resin-finished sample, were studied: green cotton, beige spun rayon and blue rayon and acetate. All were randomly wrinkled in the Celanese Tester and then subjectively evaluated as follows:

1) Subjective qualitative visual ranking from best to worst, hereinafter identified as Celanese "Test Panel Ranking".

2) Subjectively scored on a point basis employing five criteria of wrinkle-resistance performance as described below, hereinafter identified as Celanese "Total Weighted Score".

Recovery angles of the fabrics were measured by both the Monsanto and Cyanamid Testers.

Mean profile heights of randomly wrinkled samples were measured according to the method of Hebeler and Kolb (*1*). This technique consists of measuring the average height of deflections (wrinkles, folds, etc) out of the plane of the fabric.

## CELANESE CRITERIA OF WRINKLE RESISTANCE

Carolan and Mathieson (*2*) employ five criteria for "wrinkling characterization": wrinkle density, profile, sharpness of creasing, degree of mussiness, and degree of randomness. They are defined as follows:

*wrinkle density*: an estimate of the number of wrinkles per unit area of fabric, assuming complete randomness.

*profile*: an estimate of the degree to

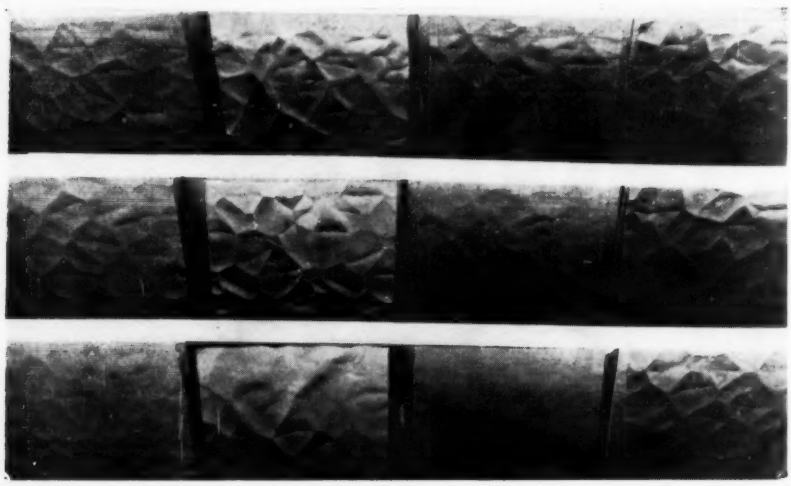


**Figure 4**
**Typical wrinkled fabrics**

which the fabric is distorted from a plane.

*sharpness of creasing:* an estimate of the roundness or sharpness of crease.

*degree of mussiness*: an estimate of the portion of the fabric displaying minute creases or rumples which give the fabric a mussed appearance.

*randomness*: an estimate of the degree to which a similar pattern exists throughout the entire specimen.

Each factor is given a rating of 0-4, depending upon the subjective reaction of the observer; the higher the number, the worse the appearance. All factors are not considered equal in their contribution to wrinkle resistance; hence, they are weighted, based upon the experience and judgment of persons using the test method. The authors state that the strongest justification for the continued use of the five factors and the weighting system lies in the fact that results so obtained appear to correlate excellently with service performance.

Weighting factors for the five criteria are:

| | |
|---|---|
| Wrinkle density | 2 |
| Profile | 5 |
| Sharpness | 3 |
| Mussiness | 3 |
| Randomness | 1 |

Table I gives typical rating and weighting values for a wrinkled fabric.

Figure 4 shows a typical panel of fabrics which have been tested in the Celanese Wrinkle Tester.

## TEST RESULTS

CELANESE TEST PANEL RANKING EVALUATION —— After random wrinkling in the Celanese Tester, the samples were allowed to relax for

### TABLE I
**Typical wrinkling evaluation score**
**Beige resin-finished fabric**

| *Criterion* | *Score* | *Weighting factor* | *Weighted score* |
|---|---|---|---|
| Wrinkle density | 2 | 2 | 4 |
| Profile | 1 | 5 | 5 |
| Sharpness | 2 | 3 | 6 |
| Mussiness | 1 | 3 | 3 |
| Randomness | 3 | 1 | 3 |
| Total Weighted Score | | | 21 |

Total Weighted Scores are classified as follows:

| | |
|---|---|
| <20 | excellent |
| 21–27 | good |
| 28–35 | fair |
| 36–45 | poor |
| >45 | very poor |

### TABLE II
**Test panel ranking of wrinkled fabrics**

| | | *After one hour* | | *After 48 hours* | |
|---|---|---|---|---|---|
| | | *Individual ranks* | *Ave rank* | *Individual ranks* | *Ave rank* |
| Blue finished | Best | Ranked 1st by six observers | 1.0 | Ranked 1st by six observers<br>Ranked 4th by one observer | 1.4 |
| Blue unfinished | | Ranked 2nd by four observers<br>Ranked 3rd by two observers | 2.3 | Ranked 1st by one observer<br>Ranked 2nd by five observers<br>Ranked 3rd by one observer | 2.0 |
| Beige finished | | Ranked 2nd by two observers<br>Ranked 3rd by four observers | 2.7 | Ranked 2nd by one observer<br>Ranked 3rd by five observers<br>Ranked 4th by one observer | 3.0 |
| Beige unfinished | | Ranked 4th by six observers | 4.0 | Ranked 2nd by one observer<br>Ranked 4th by five observers<br>Ranked 5th by one observer | 3.9 |
| Green finished | | Ranked 5th by six observers | 5.0 | Ranked 3rd by one observer<br>Ranked 5th by six observers | 4.7 |
| Green unfinished | Worst | Ranked 6th by six observers | 6.0 | Ranked 6th by seven observers | 6.0 |

### TABLE III
**Typical Weighted Score Values**
**Beige resin-finished fabric**
Evaluated by 14 observers one hour after testing
Tests made at 65% RH, 70°F

| *Weighting Factor* / *Observer* | *Wrinkle density (2)* | *Profile (5)* | *Sharpness (3)* | *Mussiness (3)* | *Randomness (1)* | *Total* |
|---|---|---|---|---|---|---|
| 1 | 4 | 5 | 6 | 3 | 3 | 21 |
| 2 | 4 | 10 | 6 | 0 | 3 | 23 |
| 3 | 4 | 10 | 6 | 6 | 2 | 28 |
| 4 | 4 | 15 | 12 | 9 | 2 | 42 |
| 5 | 6 | 15 | 6 | 3 | 2 | 32 |
| 6 | 2 | 10 | 3 | 3 | 1 | 19 |
| 7 | 4 | 15 | 9 | 9 | 3 | 40 |
| 8 | 6 | 15 | 9 | 9 | 3 | 42 |
| 9 | 6 | 15 | 9 | 9 | 3 | 42 |
| 10 | 4 | 7.5 | 4.5 | 3 | 1 | 20 |
| 11 | 4 | 15 | 4.5 | 6 | 1 | 32 |
| 12 | —— No individual data reported —— | | | | | 26 |
| 13 | —— No individual data reported —— | | | | | 38 |
| 14 | 4 | 5 | 7.5 | 7.5 | 2.5 | 27 |

one and 48 hours respectively after which times they were judged for relative appearance by six (or seven) observers. Results are given in Table II.

It may be concluded that the observers could consistently rank all fabrics in proper order, with some question as to the relative position of blue unfinished vs beige finished. These two were close to each other in general appearance, as were beige unfinished and green finished.

CELANESE TOTAL WEIGHTED SCORE EVALUATION ——— After random wrinkling in the Celanese Tester, the samples were allowed to relax for one and 48 hours respectively after which they were scored for wrinkle resistance using the five criterion and weighting values cited above. Table III shows typical data reported by fourteen observers on the beige resin-finished fabric.

Table IV shows total weighted scores for the six fabrics as determined by the 14 observers. The descriptive word for each fabric is based upon the classification given in Table I. The rank given each fabric, based upon total weighted score, is also shown.

Total weighted scores after both one and forty-eight hours show blue finished to be best and green unfinished to be worst. The beige unfinished and green finished are about the same as are the blue unfinished and beige finished. While all observers were not equally lenient or severe in their scoring, it is evident that excellent uniformity exists among observers in their ability to rank fabrics. The only major reversals in rank are those between fabrics which are apparently close in their subjective wrinkle-resistance characteristics.

COMPARISON OF SUBJECTIVE AND OBJECTIVE WRINKLE-RESISTANCE DATA———Table V tabulates Panel Rankings and Total Score Points with Monsanto Crease Angle, Cyanamid Crease Angle, and Wrinkle Height data by Hebeler and Kolb. Also included in Table V is a rank comparison of all tests.

Perfect rank correlation exists between total weighted scores determined one and 48 hours after wrinkling. After 48 hours, scores are lower, indicating the tendency of fabrics to recover and shed wrinkles.

Almost perfect rank correlation exists between the Panel Rankings and the Total Weighted Scores. The only reversal is that between beige finished and blue unfinished and probably the differences shown are insignificant.

Figure 5 shows a plot of Cyanamid vs Monsanto crease angles, showing good correlation to exist. Rankwise correlation is almost perfect, for only in the green finished and the beige unfinished does a reversal exist.

Figure 6 shows a plot of Monsanto Crease Angles vs Celanese Total Weighted Scores. Excellent correlation is shown, thus demonstrating that a relationship does exist between the subjective - qualitative - opinion-type evaluation taken from the Celanese

## TABLE IV
## Total Weighted Scores
### Celanese Wrinkle Test evaluation

**Evaluated one hour after wrinkling**

| | Green | | Beige | | Blue | |
|---|---|---|---|---|---|---|
| *Observer* | *Unfinished* | *Finished* | *Unfinished* | *Finished* | *Unfinished* | *Finished* |
| 1 | 56 | 46 | 36 | 21 | 23 | 11 |
| 2 | 56 | 43 | 28 | 23 | 26 | 15 |
| 3 | 51 | 37 | 56 | 28 | 36 | 21 |
| 4 | 44 | 34 | 44 | 42 | 34 | 18 |
| 5 | 56 | 53 | 45 | 32 | 44 | 33 |
| 6 | 53 | 56 | 34 | 19 | 31 | 20 |
| 7 | 56 | 46 | 54 | 40 | 35 | 22 |
| 8 | 56 | 45 | 51 | 42 | 53 | 16 |
| 9 | 56 | 51 | 55 | 42 | 42 | 30 |
| 10 | 50.5 | 46.5 | 41 | 20 | 30 | 15.5 |
| 11 | 53 | 55 | 36 | 32 | 36 | 14 |
| 12 | 53 | 41 | 35 | 26 | 32 | 24 |
| 13 | 51 | 45 | 41 | 38 | 41 | 22 |
| 14 | 42 | 36 | 32 | 27 | 35 | 24 |
| Ave Score | 52.4 very poor | 45.3 poor | 42.0 poor | 30.9 fair | 35.6 fair | 20.4 excellent |
| | | | *Rank* | | | |
| 1 | 6 | 5 | 4 | 2 | 3 | 1 |
| 2 | 6 | 5 | 4 | 2 | 3 | 1 |
| 3 | 5 | 4 | 6 | 2 | 3 | 1 |
| 4 | 5T | 2T | 5T | 4 | 2T | 1 |
| 5 | 6 | 5 | 4 | 1 | 3 | 2 |
| 6 | 5 | 6 | 4 | 1 | 3 | 2 |
| 7 | 6 | 4 | 5 | 3 | 2 | 1 |
| 8 | 6 | 3 | 4 | 2 | 5 | 1 |
| 9 | 6 | 4 | 5 | 2T | 2T | 1 |
| 10 | 6 | 5 | 4 | 1 | 3 | 2 |
| 11 | 5 | 6 | 3T | 2 | 3T | 1 |
| 12 | 6 | 5 | 4 | 2 | 3 | 1 |
| 13 | 6 | 5 | 3T | 2 | 3T | 1 |
| 14 | 6 | 5 | 3 | 2 | 4 | 1 |
| Ave Rank | 5.7 | 4.6 | 4.1 | 2.0 | 3.0 | 1.2 |

**Evaluated 48 hours after wrinkling**

| | Green | | Beige | | Blue | |
|---|---|---|---|---|---|---|
| *Observer* | *Unfinished* | *Finished* | *Unfinished* | *Finished* | *Unfinished* | *Finished* |
| 1 | 56 | 43 | 25 | 12 | 15 | 6 |
| 2 | 56 | 43 | 29 | 25 | 29 | 15 |
| 3 | 53 | 32 | 56 | 28 | 30 | 12 |
| 4 | 55 | 45 | 41 | 34 | 34 | 17 |
| 5 | 56 | 51 | 51 | 54 | 32 | 20 |
| 6 | 47 | 40 | 24 | 14 | 22 | 11 |
| 7 | 56 | 42 | 40 | 37 | 35 | 14 |
| 8 | 48 | 44 | 42 | 21 | 39 | 14 |
| 9 | 56 | 47 | 49 | 31 | 38 | 14 |
| 10 | 41 | 39.5 | 28.5 | 14 | 18.5 | 10.5 |
| 11 | 50 | 39 | 24 | 16.5 | 19.5 | 8 |
| 12 | 50 | 41 | 35 | 26 | 27 | 22 |
| 13 | 51 | 38 | 40 | 38 | 37 | 17 |
| 14 | 42 | 30 | 34 | 25 | 30 | 24 |
| Ave Score | 51.2 very poor | 41.0 poor | 37.0 poor | 26.8 good | 29.0 fair | 14.6 excellent |
| | | | *Rank* | | | |
| 1 | 6 | 5 | 4 | 2 | 3 | 1 |
| 2 | 6 | 5 | 3T | 2 | 3T | 1 |
| 3 | 5 | 4 | 6 | 2 | 3 | 1 |
| 4 | 6 | 5 | 4 | 2T | 2T | 1 |
| 5 | 6 | 3T | 3T | 5 | 2 | 1 |
| 6 | 6 | 5 | 4 | 2 | 3 | 1 |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 8 | 6 | 5 | 4 | 2 | 3 | 1 |
| 9 | 6 | 4 | 5 | 2 | 3 | 1 |
| 10 | 6 | 5 | 4 | 2 | 3 | 1 |
| 11 | 6 | 5 | 4 | 2 | 3 | 1 |
| 12 | 6 | 5 | 4 | 2 | 3 | 1 |
| 13 | 6 | 4 | 5 | 2 | 3 | 1 |
| 14 | 6 | 3T | 5 | 2 | 3T | 1 |
| Ave Rank | 5.9 | 4.5 | 4.2 | 2.3 | 2.8 | 1 |

T = Tie.

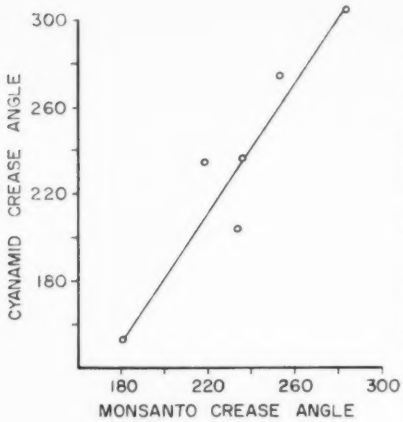



**Figure 5**
**Monsanto vs Cyanamid crease-recovery angles**

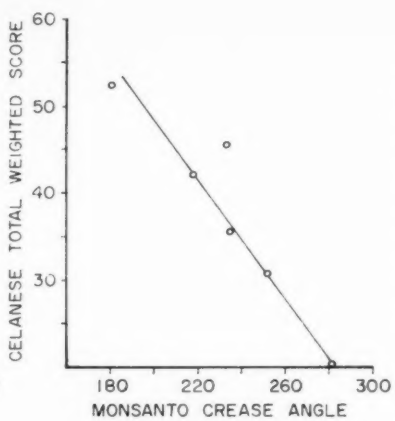



**Figure 6**
**Monsanto crease-recovery angle vs Celanese Total Weighted Score**

## TABLE V . .
### Comparison of subjective and objective wrinkle resistance data

Subjective criteria: Celanese Test Panel Ranking; Celanese Total Weighted Score

Objective criteria: Monsanto Crease Angle; Cyanamid Crease Angle; Mean Wrinkle Height

| | *Green* | | *Beige* | | *Blue* | |
|---|---|---|---|---|---|---|
| | *Unfinished* | *Finished* | *Unfinished* | *Finished* | *Unfinished* | *Finished* |
| *Test Panel Rank* | 6.0 | 4.7 | 3.9 | 3.0 | 2.0 | 1.4 |
| *Total Weighted Score* | | | | | | |
| One hour | 52.4 | 45.3 | 42.0 | 30.9 | 35.6 | 20.4 |
| 48 hours | 51.2 | 41.0 | 37.0 | 26.8 | 29.0 | 14.6 |
| *Monsanto Crease Angle (warp & filling)* | | | | | | |
| | 187° | 246° | 264° | 297° | 286° | 313° |
| | 164 | 208 | 165 | 181 | 173 | 219 |
| | 194 | 246 | 231 | 271 | 237 | 314 |
| | 180 | 233 | 213 | 259 | 243 | 283 |
| Average | 181° | 233° | 218° | 252° | 235° | 282° |
| *Cyanamid Crease Angle (warp & filling)* | 153° | 204° | 234° | 274° | 236° | 304° |
| *Mean Wrinkle Height (Hebeler & Kolb)* | 1.186 | 0.911 | 1.259 | 1.153 | 1.259 | 0.798 |
| | *Rank Comparison* | | | | | |
| *Total Point Score* | | | | | | |
| One hour | 6 | 5 | 4 | 2 | 3 | 1 |
| 48 hours | 6 | 5 | 4 | 2 | 3 | 1 |
| Test Panel Rank | 6 | 5 | 4 | 3 | 2 | 1 |
| Monsanto Angle | 6 | 4 | 5 | 2 | 3 | 1 |
| Cyanamid Angle | 6 | 5 | 4 | 2 | 3 | 1 |
| Mean Wrinkle Height | 4 | 2 | 5-6 | 3 | 5-6 | 1 |

Tester and the objective-quantitative-laboratory-type test, as measured by the Monsanto Method. While a large number of fabrics of a wide range of fiber compositions and fabric constructions would have to be evaluated to warrant making any definite and positive conclusions, it does appear probable (or possible) that the Monsanto-type test is correlative with the subjective-random-service-type tests. Here is evidence (additional work should be done to substantiate) that the rapid - quantitative - crease - angle test has considerable value as a method for judging the wrinkling characteristics of fabrics.

The Mean Wrinkle Height values do not appear to correlate well with either the subjective Celanese Wrinkle Test results or the objective crease-angle measurements. One might conclude that the measurement of vertical displacement from the plane of a fabric cannot be used as a sole criterion of wrinkling.


## SUMMARY

Six fabrics were evaluated for tendency to wrinkle by the Celanese Wrinkle Tester. This instrument wrinkles fabrics in a reproducible but random manner. Two subjective qualitative visual criteria were employed to evaluate fabrics so wrinkled: first, an over-all subjective opinion of relative rank; second, a weighted score method employing five subjective opinion criteria of wrinkling tendency. Excellent correlation exists between the two methods.

The fabrics were quantitatively measured for crease recovery angle by the well-known Monsanto and Cyanamid methods. Excellent rank correlation exists between these two methods.

Excellent correlation exists between the qualitative - subjective weighted score and the Monsanto quantitative-objective-recovery angle methods.

Fabrics wrinkled in the Celanese Tester were quantitatively measured for Mean Wrinkle Height as a criterion of wrinkling tendency. Poor correlation exists between this technique and either the Celanese Panel Rank, the Weighted Score, the Monsanto, or the Cyanamid Tests.

In spite of the apparent value of the Celanese Wrinkle Test Method, the AATCC Committee for the Evaluation of Creasing Properties of Fabrics voted not to adopt it as a standard. This is because the subsequent evaluation is qualitative and subjective. It is felt that the textile industry must have, wherever possible, an objective test method such that results can always be measured quantitatively in a prescribed fashion, independent of the subjective personal opinion of an observer.

It will be obvious that many of the problems concerning the evaluation of wrinkling are identical with those concerning the evaluation of "wash and wear." It is suggested therefore, that the Weighted Score Method described herein may prove of benefit for such evaluations. The Hebeler and Kolb Method, while it did not show correlation with the other tests, appears intriguing because it attempts to quantify the effect of random wrinkling. Possibly further study might result in this instrument's ultimately being employed to place present qualitative evaluations on a quantitative basis.


## LITERATURE CITED


(1)Hebeler, H H, and Kolb, H J, "The Measurement of Fabric Wrinkling," *Textile Research J* 20, 650 (1950).

(2)Carolan and Mathieson, private communication.

# Activities of the Local Sections

## Delaware Valley

THE ANNUAL Ladies Night meeting of the Delaware Valley Section will be held on Saturday evening, April 11 at Kugler's Restaurant, Philadelphia, Pa. A gay Mardi Gras atmosphere will prevail throughout the evening with music and decorations highlighting the theme. After dinner, there will be dancing and games to entertain members and guests.

## Piedmont

AN ATTENDANCE of 450 to 500 members is anticipated at the Spring Meeting of the Piedmont Section, which will be held this Saturday (April 11) at the Hotel Robert E Lee, Winston-Salem, NC.

"Research and the Future of North Carolina" will be the theme of the Meeting, at which George L Simpson will be the principal speaker. Dr Simpson is director of the Governor's Research Triangle of Raleigh-Chapel Hill, NC, a State-sponsored organization whose purpose is to encourage the establishment of private, industrial research laboratories in the Chapel Hill-Durham-Raleigh area, where they will be able to take advantage of the extensive research facilities of Duke Univ, Univ of North Carolina, and North Carolina State College.

Other notables expected to attend the meeting include Fred Wedler, president, Burlington Finishing Co; Archie K Davis, chairman of the board, Wachovia National Bank of Winston-Salem and other North Carolina cities; and Sydney M Cone Jr, vice president of Cone Mills Corp.

## Metropolitan

ROBERT M LESH, superintendent, Northern Dyeing Corp, Washington, NJ, will speak on the subject "Practical Experience with the Pad-Roll Dyeing Machine" at the April 10th meeting of the Metropolitan Section, which will be held at Kohler's Swiss Chalet, Rochelle Park, NJ.

## Northern New England

FUTURE meetings of the Northern New England Section have been set as follows:

*May 15*—LTI Technical Program at Lowell Technological Institute, Lowell, Mass

*Sept 18*—Annual outing at Wachusett Country Club, West Boylston, Mass

*Oct 16*—Meeting at Lexington Inn, Lexington, Mass. A J Farnworth, CSIRO, Melbourne, Australia, and Gerald Laxer, The Wool Bureau, Inc, will discuss "The SI-RO-SET Process".

*Dec 4*—Joint symposium with the Textile Engineering Div, ASME, at the Smith House, Cambridge, Mass

*Jan 15*—Meeting at the Woodlawn Golf Club, Newton, Mass. Subject will be "Wash and Wear—Wool and Cotton Fabrics".

# Employment Register

*This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the secretary of the Association, Post Office Box 28, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the secretary.*

59-4

*Education:* Lawrence (Mass) High School; Lowell Technological Institute
*Experience:* Supt, dyeing, bleaching & finishing
*Position desired:* Dyehouse mgr
*Location:* Metropolitan New York, New England
*Age:* 45; married; references

4-6, 4-20

59-5

*Education:* High school
*Experience:* Plant supt and supt, anodizing sales
*Position desired:* sales or purchasing
*Location:* Mid-West
*Age:* 47; married, excellent references

4-6, 4-20

59-6

*Education:* Graduate with honors in chemistry and physics, Bombay Univ, and training in dyeing and printing at Imperial Chemical Industries, Ltd, Bombay, India
*Experience:* 13 yrs, wet processing in Indian textile mills, including compressive shrinking, mercerizing, printing, etc
*Position desired:* Supervisory capacity in American Textile mill, wet processing dept
*Location:* Anywhere in USA
*Age:* 34; married

4-6, 4-20

# Membership Applications

SENIOR

**Johnny F Barkley**——Supv dyeing, Barwick Carpet Mills, Lafayette, Ga. Sponsors: J M Stephenson, G E Jones. (SC).

**George H Curtis**——Proj investigator, Dev Dept, Lion Oil Div, Monsanto Chem Co, Houston, Texas. Sponsors: G O Linberg, W C Caldwell Jr. (PSW).

**Bryan D England**——Lab tech, Springfield Woolen Mills, Springfield, Tenn. Sponsors: L A Shive, A R Williams Jr. (SC).

**Rudolph F Fischer**——Research supv, Plastics & Resins, Shell Dev Co, Emeryville, Calif. Sponsors: D D Gagliardi, F B Shippee. (PSW).

**Bianchi Gerardo**——Chem consultant, Societa Italiana Resine, Sesto S Giovanni, Milan, Italy. Sponsors: M Grossi, Italo Ottina.

**Hazel E Harris**——Textile technologist, Harris Research Labs, Washington, DC. Sponsors: A E Davis, J F Krasny. (W).

**Victor A Jones**——Vice president, United States Supply Co Inc, East Providence, RI. Sponsors: K J Broden, D C Hardman. (RI).

**George J Leitner**——Research chem, Textile Pigment Research Lab, Geigy Chem Corp, Yonkers, NY. Sponsors: T Skeuse Jr, R C Allison. (M).

**Dwight B Morris**——Overseer dyeing, finishing & preboarding, Wiscassett Knitting Dept, Cannon Mills Co, Albermarle, NC. Sponsors: T R Smith, C H Morris. (P).

JUNIOR

**Gary McVey**——Asst dyer, Kayser-Roth Hosiery Co, Burlington, NC. Sponsors: T H Pike, C M Spoon. (P).

**Doris I Rossman**——Lab asst, Harris Research Labs, Inc, Washington, DC. Sponsors: J F Krasny, A E Davis. (W).

ASSOCIATE

**Paul C Cassidy**——Research chem, A C Lawrence Leather Co, Peabody, Mass. (NNE).

**David W Crookall**——Tech sales, Atlas Refinery Inc, Newark, NJ. (M).

**H Dorn Stewart Jr**——Tech sales, Allied Chem Corp, National Aniline Div, Philadelphia, Pa. (DV).

STUDENT

**Frances B S Davis**——Student, Lowell Technological Institute, Lowell, Mass.

**James M Fulford**——Student, Institute of Textiles, St Hyacinthe, Quebec, Canada. Sponsor: G Boule.

## *COLOUR INDEX NOW COMPLETE!*

### ALL FOUR VOLUMES
### OF THE NEW

# COLOUR INDEX

### NOW AVAILABLE

---

The First Edition of the COLOUR INDEX was published in 1924 and now, thirty-four years later, the Second Edition is ready for you. You cannot afford to wait for some future edition. There is no other up-to-date index of world coloring matters.

---

Your prepaid subscription received promptly will insure your possession of this LIMITED EDITION, a tremendously valuable work on the free world's dyestuffs and pigments in commercial use. Published by the Society of Dyers and the Colourists (British) and the American Association of Textile Chemists and Colorists, these four volumes totaling 3152 pages provide the only complete reference of coloring matters available to those interested in this field. They include information on methods of application and fastness properties of coloring matters furnished by world manufacturers, chemical and structural information, characteristic reaction, index of products and trade names, fastness tests and rating methods, new and old COLOUR INDEX NUMBERS, Schultz and AATCC prototype numbers and a hue indication chart.

---

**PREPAID SUBSCRIPTION FOR THE FOUR VOLUMES IS $112.00 PER SET, PACKAGED AND DELIVERED**

---

**ORDER NOW FROM:**

***American Association of Textile Chemists and Colorists***

***PO Box 28, Lowell, Massachusetts***

# News of the Trade

## Fiber Society's Spring Meeting Program Set

A textile educator's appraisal of the problems which face his field, a discussion of the space era by a leader in Air Force Research, and seven technical papers in fiber science are highlights of the program scheduled for the spring meeting of the Fiber Society at Fontana Village, NC, April 29-30.

Martin J Lydon, president, Lowell Technological Institute, will discuss "Science, Engineering and Textile Education," and the new challenges in education the textile industry faces as modern technology advances.

The Air Force speaker will be Harris M Burte, chief, Programming Branch, Operations Office, Materials Laboratory, for the Wright Air Development Center at Wright-Patterson Air Force Base, Ohio. In his talk, entitled "Materials Research—The Key to Progress in Aeronautics and Astronautics," he will discuss some of the more important research requirements surrounding the Air Force materials program.

The Fiber Society is an organization composed of men engaged in research work in fibers, fiber products and fibrous materials, who meet twice annually for discussions designed to advance scientific knowledge in these fields. President of the Society is S Jack Davis, of the Chemstrand Corporation, Decatur, Ala. Program chairman for the spring meeting is Howard White of Textile Research Institute.

The technical papers during the two-day meeting will include: "The Stabilizer in Hydrogen Peroxide Bleaching," by David M Cates, North Carolina State College, School of Textiles; "Continuous and Time-Lapse Motion Pictures Through the Microdyeoscope." by Henry E Millson, American Cyanamid Co, Bound Brook, NJ; "Response of Several Cottons to Chemical Tretments," by L Rebenfeld, Textile Research Institute, Princeton, NJ; "Stress-Strain Behavior of Nylon in Tension and Compression," by John B Miles, Chemstrand Corp, Decatur, Ala; "Theory of Fiber Friction," by Henry M Morgan, Fabric Research Laboratories Inc, Dedham, Mass; "Production of Fibers by Spraying," by Derek E Till, Arthur D Little Inc, Cambridge, Mass; and "The Characterization of Fabric Streaks," by Ferdinand Schulze, DuPont Co, Wilmington, Del.

Air Reduction Chemical Co's new $400,000 installation at Bound Brook, NJ

## Air Reduction Opens New Development Facilities

Air Reduction Chemical Co, a division of Air Reduction Co, Inc, last month opened a new chemical laboratory and engineering office building in the Bound Brook, NJ, area. The new $400,000 installation is an expansion of the Company's existing development facilities at Bound Brook. Adjacent to the Airco pilot plants, the new building will be the center for the development of chemical processes and products and for research on product applications.

At ceremonies marking the opening of the new building, the principal speaker was John A Hill, president of Air Reduction Co, Inc. The president of Air Reduction Chemical Co, C J McFarlin, discussed the objectives of the new laboratory with particular emphasis on the development of new and improved chemical products and assistance to customers in the use of these products. The speakers were introduced by Glenn F Kennedy, manager of the new installation.

Research and development at Bound Brook will support Airco's facilities at Calvert City, Ky, for the manufacture of vinyl acetate, vinyl stearate, methyl butynol, and methyl pentynol. A new plant to produce 20 million pounds per year of polyvinyl alcohol resin is now under construction. These chemicals are derived from acetylene, generated from calcium carbide at Air Reduction's Calvert City plant.

At Bound Brook, an expanded technical sales laboratory will work closely with customer companies. Headed by C E Blades, the staff of 8-10 graduate chemists will evaluate products and formulations, explore new applications, and evolve specifications to meet customers' needs.

In addition to laboratory space, the air-conditioned building contains a test area, engineering and general offices, and service rooms. There is work space for 50-60 office employees, engineers, chemists and technicians. The building covers 10,000 square feet and is the first structure on a 35-acre tract purchased by Air Reduction in 1957. Construction started in June 1958. The design provides for expansion of the structure in any direction.

Air Reduction Chemical Company is a major producer of vinyl acetate monomer, and reputedly is the only commercial producer in the United States of vinyl stearate, methyl butynol and methyl pentynol. Other products of Air Reduction Chemical Co include surface-active agents and a variety of acetylenic alcohols and glycols.

Headquarters of Air Reduction Chemical Company are at 150 East 42nd St., New York 17, NY.

---

## Cyanamid International Forms Fibers Dept

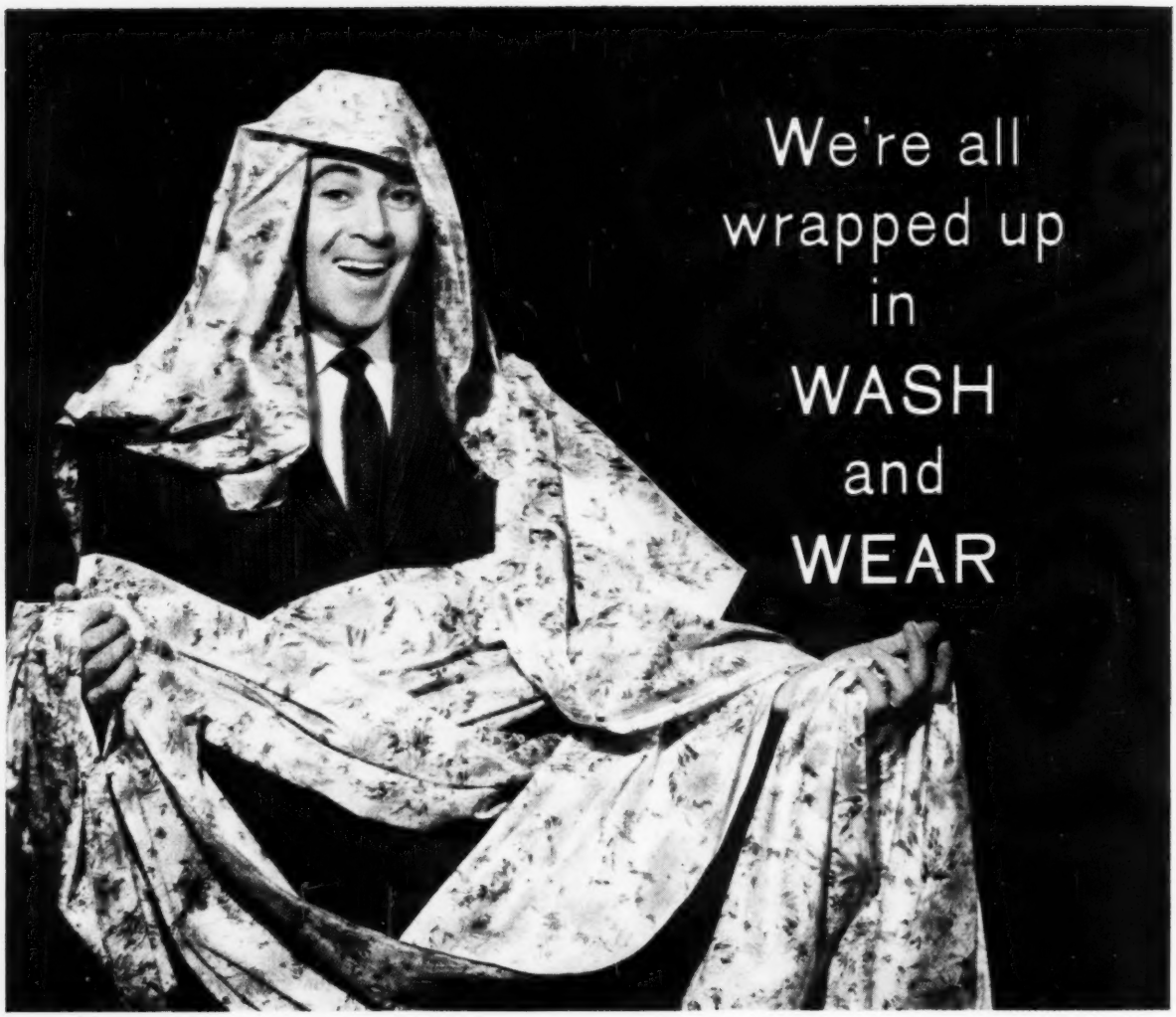
Cyanamid International has announced the formation of a fibers Department to handle overseas sales of the company's new acrylic fiber, Creslan.

Eugene J Lukas, former product manager of the organic chemicals section, General Chemicals Department, was named to head up the new department.

The announcement was made by Sidney C Moody, director-general of Cyanamid International, world-wide operating division of American Cyanamid Company.

The new department corresponds to the company's domestic Fibers Division, formed in mid-1957. Test quantities of Creslan have been produced at Cyanamid's Stamford, Conn, research facility, and a commercial plant at Santa Rosa, near Pensacola, Fla, is expected to begin supplying industry shortly.

Appointed to fill the vacancy left by Mr Lukas' assignment is G I Trull, formerly sales manager for the Fine Chemicals Section of the international division.




**Your problems did it to us . . . so now we'd like to show you some of the things we've learned**

Take the problem of crushproofing, for instance. From years in the laboratory and many hours in finishing plants (maybe yours was among them) Rohm & Haas textile men found a way to get crushproofing resins and reactants *inside* the fibers of fabrics.

You know these resins by the name, RHONITE. In polymeric and monomeric forms, they are widely used not only for crushproofing, but also for stabilization, stiffening, and durable calendered effects on cottons, synthetics and blends.

In developing products like these RHONITE resins, we also have found ways to streamline finishing operations, cut costs and improve the wearability and salability of fabrics. When you decide on a particular RHONITE, or any other of the many Rohm & Haas textile chemicals, you share this knowledge, too, at no extra charge.

Our line of wash-and-wear resins is complete, so that it is indeed an unusual end use or processing condition that one of these resins would not fit. Why not let us bring you up to date on what's new in textile chemicals at Rohm & Haas?

RHONITE *is a trademark, Reg. U.S. Pat. Off. and in principal foreign countries.*

*Chemicals for Industry*

**ROHM & HAAS COMPANY**

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

# RHONITE

## World Document Center Near?

Possibility of the establishment of a scientific world document center appears nearer with the announcement by Western Reserve University President John S Millis, that the General Electric Co would build a high-speed prototype of the WRU searching selector called the GE-250.

Millis said this is an historic occasion for the University as it will enable the WRU document specialists to search scientific and other documents much more rapidly and efficiently and will furnish the proposed world document center with one of its most important tools.

A GE spokesman said the GE-250 is designed to allow automatic reviewing and comparing, at very high speed, of extensive files of information to determine which piece of information answers in whole or part a specific inquiry.

Commenting on the new machine, Jesse H Shera, dean of the WRU School of Library Science, believes "it could revolutionize the field of librarianship and library education as much as computers have revolutionized accounting."

James W Perry, director of the WRU Center for Documentation and Communication Research, said some idea of the importance and significance of the new machine to scientific searchers could be grasped when one realized that the old WRU selector could search 30 abstracts per hour while the new one when completed will search 100,000 abstracts per hour.

Perry said the General Electric Co would build the searching selector under a non-exclusive license for the duration of the patent. It marks GE's entry into the field of automatic library searching equipment.

Allen Kent, associate director of the WRU center, recently returned from a trip to Russia where he visited the Soviet Union's giant scientific information center. From his observations on that trip he believes that the acquisition of the GE-250 will put the US back in the running with the USSR in regard to the mastery of scientific and technical information.

More significant for industry, according to Dr Millis, the new machine will be able to search the year's output of the world's chemical literature in one hour, or an entire collection of company reports in several minutes. He said the machine would complement the work of large computers in providing processed data for management decisions.

The first large-scale push in the US for an effective world document serve University in February of 1958 when representatives of 150 professional and technical societies, government agencies, foundations and industry met to consider WRU's plan for the coordination of the world's scientific and technical information.

Major steps since that time include: hearings in May of 1958 before Senator H H Humphrey's subcommittee on reorganization (Committee on Government Operations); presentation of the WRU plan to the National Research Council for study in mid-1958; the trip to Moscow by Allen Kent to study Russian developments in scientific documentation in September, 1958; and John S Millis' recent appointment to the advisory committee of the Science Information Service of the National Science Foundation.

## Correction

In the article "Research on Dyeing of Cyanoethylated Fibers" by Helmut Waibel, which appeared in the October 6, 1958 issue, the formulations at the bottom of the second and third columns of page 675 are incorrect.

These should read as follows:

a) $NC-CH=CH_2+H_2O \xrightarrow{NaOH} NC-CH_2-CH_2-O-CH_2-CH_2-CN$

b) $Cell\ O-CH_2-CH_2-CN+H_2O \xrightarrow{NaOH} Cell\ O-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-NH_2$

$Cell\ O-CH_2-CH_2-CN+2H_2O \xrightarrow{NaOH} Cell\ O-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-OH+NH_3$

## LTI Textile Scholarships Available

Scholarship funds from industry are available to students majoring in the various textile courses at Lowell Technological Institute for the coming academic year, according to Dean of Students Richard W Ivers. Application should be made to the director of admissions, Lowell Technological Institute, Lowell, Mass, and freshman applicants for admission, as well as for scholarships, must complete the Scholastic Aptitude Test of the College Entrance Examination Board.

Following are the endowing companies and the terms of their scholarships:

Arthur Besse memorial trust scholarship of $500 to a student majoring in textiles.

Chemstrand Corp, $500 to a senior in textiles.

Ciba Co, Inc, $500 each to a senior and a junior in textile chemistry.

Sylvan I Stroock scholarship of S Stroock & Co, Inc, $500 to a textile major, demonstrating financial need, scholastic ability and promise of success.

Owens-Corning Fiberglas, $375 each to a junior and a senior in engineering or textiles.

Ralph E Hale memorial scholarship of the Northern New England Section, American Association of Textile Chemists and Colorists, $250 to a senior in textile chemistry.

Gehring Foundation memorial scholarship, $150 to a textile major showing promise of success.

Samuel P Kaplan memorial scholarship given by the New England Knitted Outerwear Manufacturers' Association, $100 each semester to the student ranking highest in advanced knitting.

Albany Felt Co, $500 to a freshman planning to major in textile engineering, renewable in subsequent years.

Davis and Furber Co, $300 to a textile engineering or textile technology major, preferably an employee or son of an employee.

United Elastic Corp, $250 to two employees or members of employees' families.

Berkshire-Hathaway, Inc, tuition and living expenses to an employee or son of an employee.

US Rubber Co, $500 to a senior without stipulation as to course, incurring an obligation to repay 25% of the amount after graduation.

Shapiro Brothers, two $500 scholarships for students demonstrating financial need and scholastic ability, without stipulation as to course.

Burlington Industries, $500 each to a junior and senior in engineering.

Numerous other scholarships are offered in chemistry and in leather, paper, and plastics engineering. in addition to the general scholarships for all students made available through the LTI Alumni Association, the city of Lowell, and the Commonwealth of Massachusetts. Among the several scholarships open to entering freshmen is the Jacob Ziskind memorial scholarship.

# DUROFAST BROWNS

BRI
3RLI
5RLI

Lasso your most elusive shades easily with **DUROFAST,** and you can be sure they will stay put.

**DUROFAST** colors offer exceptional fastness to light and washing and are suitable for resin after-treatments.

*Write now for color cards, samples and technical data.*

Berkshire

COLOR & CHEMICAL CO.

*Manufacturing and Executive Offices*

DELAWANNA, N. J.

210 Albany Street, SPRINGFIELD 5, Mass.

Stocks maintained at:
CHARLOTTE • GREENVILLE
CHARLESTON and LOS ANGELES

Canadian Representative:
Consolidated Dyestuff and Chemical Ltd., 395 Beaumont Ave., Montreal 15, Canada

## Methylamines in Small Cylinders

Rohm & Haas Co is now offering monomethylamine, dimethylamine, and triethylamine anhydrous in laboratory and developmental size five and 25-pound cylinders, which supplement the currently available 50-and 100-pound cylinders.

The methylamines are described as low-priced, reactive intermediates which represent the most economical sources of aliphatic organic nitrogen.

Further data and prices are available from Special Products Department, Rohm & Haas Company, Washington Square, Philadelphia 5, Pa.

## Directory of Available Translations

The Department of Commerce began publication in January of a periodical planned to serve as a central source of information in the United States on Russian and other technical translations available to science and industry.

The periodical, *Technical Translations*, will be published twice a month by the Office of Technical Services, in cooperation with the Special Libraries Association. It will list and abstract translated material available from U S Government sources, SLA, cooperating foreign governments, educational institutions, and private sources.

As part of the cooperative arrangement between OTS and the Special Libraries Association, SLA's *Translation Monthly* will be incorporated in *Technical Translations*.

The Office of Technical Services was authorized by the last Congress to serve as a national "clearinghouse" for technical and scientific translations. For over 13 years, the Office has been collecting, cataloging, reproducing, and distributing to science and industry the technical reports growing out of U S Government-financed research. These functions were expanded by the Congress to include scientific and technical translations, prepared by agencies of the Federal Government and other organizations.

Most of the foreign material OTS is collecting from the Government agencies has not been previously available to the public, and the volume from this source alone is expected to run as high as 10,000 complete translations a year. Abstracts of this material began appearing in *Technical Translations* in January.

*Technical Translations* will be sold by OTS at $12 a year ($4 additional for foreign mailing). Single copy is 60 cents. Orders should be addressed to OTS, U S Department of Commerce, Washington 25, DC.

**Century-old skein reeler, one of several pieces of antique knitting mill equipment which will be displayed at the Knitting Arts Exhibition in May, draws the attention of Charlene Holt, reigning Sweater Queen. In the background is an old hand-operated knitting frame. The knitting show, which is scheduled for May 4-8 in the Civic Auditorium at Atlantic City, N J, is expected to draw a record number of American and foreign manufacturers of knitted outerwear, hosiery and underwear. Close to 200 firms will demonstrate new modern high-speed machines for knitting, dyeing and finishing seamless and full-fashioned hosiery, sweaters of wool, cotton, and a variety of synthetic fibers, and new lightweight thermal underwear.**

**Miss Holt, who won her title during nation-wide observance of National Sweater Week last September, will also be one of the attractions at the knitting exposition. The show is held biennally under the sponsorship of the National Association of Hosiery Manufacturers, the Underwear Institute, and the National Knitted Outerwear Association.**

## Clemson Offering Short Course in Textiles

A short course program in textiles, offering five courses, will be conducted this summer at Clemson College School of Textiles.

Courses beginning June 15 are planned, in order, in yarn manufacturing, fabric development, supervisor development, motion and time study, and quality control. Each course will be presented as a full-time program, running for three weeks with no classes on Friday afternoons or Saturday mornings.

No entrance examinations nor college credit will be given.

Beginning dates for the three-week classes are June 15, in yarn manufacturing; July 6, fabric development; July 6, supervisor development; July 15, motion and time study; July 27, quality control.

The schedule enables a student to take more than one course. Courses may be repeated if there is sufficient demand.

## Solitone License in Brazil

Solitone Laboratories, Teaneck, NJ has announced the granting of a license to Schilling-Hillier, SAIC, Rio de Janeiro, Brazil, for the manufacturer of Solitone textile printing and dyeing colors.

The Solitone colors are pigmented oil-in-water emulsions which are said to be characterized by brilliant shades and outstanding fastness to wet and dry abrasion. Brazil is the third South American country where Solitone Colors will be produced, licenses having been already granted in Colombia and Argentina.

Schilling-Hillier, SAIC is one of Brazil's leading chemical and pharmaceutical manufacturers. They reputedly are the country's largest producer of acrylic resins, leather finishes and adhesives; and specialize in raw materials for the protective and decorative coatings industries.

# General Calendar

**AMERICAN COTTON MANUFACTURERS INSTITUTE**
April 15-16 (ACMI Cotton Fiber Testing Lab Open House, The Clemson House, Clemson, SC

**AMERICAN OIL CHEMISTS SOCIETY**
April 20-22, 1959 (Roosevelt Hotel, New Orleans, La; Sept 28-30, 1959 (Statler Hotel, Los Angeles, Calif)

**AMERICAN TEXTILE MACHINERY ASSOCIATION**
May 23-27, 1960 (American Textile Machinery Exhibition, Auditorium, Atlantic City, NJ)

**CANADIAN ASSOCIATION OF TEXTILE COLOURISTS AND CHEMISTS (QUEBEC SECTION)**
Apr 18 (McGill Univ, Montreal, Que); June 20 (Annual Golf Tournament)

**DRUG, CHEMICAL AND ALLIED TRADES SECTION, NY BOARD OF TRADE**
Sept 17-20 (69th Annual Meeting, Sagamore Hotel, Bolton Landing, Lake George, NY

**GORDON RESEARCH CONFERENCE ON TEXTILES**
July 13-17 (Colby Jr College, New London, NH)

**THE FIBER SOCIETY**
April 29-30 (Fontana Village, NC)

**KNITTING ARTS EXHIBITION**
May 4-8 (Atlantic City Auditorium, Atlantic City, NJ)

**NATIONAL COTTON COUNCIL**
May 12-14 (1959 Cotton Research Clinic, Grove Park Inn, Asheville, NC)
Oct 7 (Chemical Finishing Conference, Mayflower Hotel, Washington, DC)

**PHI PSI FRATERNITY**
April 23-25 (56th Annual Convention—Atlanta Biltmore Hotel, Atlanta, Ga)

**PURDUE INDUSTRIAL WASTE CONFERENCE**
May 5-7 (Purdue Memorial Union Bldg. Purdue Univ, Lafayette, Ind)

**SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION OF THE UNITED STATES**
April 14, June 9, Sept 15, Oct 13, Nov 4 (Luncheon meetings at the Hotel Roosevelt, New York, NY); May 11-13 (Spring Outing—The Cavalier, Virginia Beach, Va); Dec 2 (Annual meeting and dinner—Hotel Roosevelt, New York, NY)

# • NEW PRODUCTS AND DEVELOPMENTS •

## Nylomine Dyestuffs

Availability of a new range of dyes, the Nylomine dyestuffs, designed for dyeing nylon and other polyamide fibers, has been announced by Arnold, Hoffman & Co, Inc, 55 Canal St, Providence, RI.

The outstanding property of the Nylomine dyestuffs, according to Arnold, Hoffman, is their ability to produce bright shades having high lightfastness, and good fastness to wet treatments. Excellent wetfastness can be achieved by a simple "back-tanning" treatment, it is claimed. Nylomine dyes reportedly may be applied to nylon and other polyamides in the form of loose fiber, slubbing, yarn or piece goods.

Included in the Nylomine range at present are nine colors, listed as Blue GS, Blue R, and Dark Blue B; Yellow GS; Orange GS; Red 2BS; Scarlet B; Brown B; and Black BS. All the Nylomine dyes are said to be compatible with each other and to exhibit similar dyeing and fastness properties.

The anionic Nylomine dyestuffs are described as having excellent building-up properties. Like other anionic dyestuffs they do not cover irregular-dyeing nylon, but experience is said to show their behavior on irregular-dyeing nylon to be superior to others currently available.

Imperial Chemical Industries Ltd, England, of which Arnold, Hoffman is the United States subsidiary, developed this new class of dyes.

---

## Heliogen Viridine Y

Heliogen Viridine Y, regarded by General Dyestuff Co as a major breakthrough in phthalocyanine chemistry, culminates ten years of research work by General Aniline & Film Corp.

The new pigment reportedly makes possible vivid, lightfast yellow-green colors free of dichromatic effect often exhibited by mixtures of yellow and green pigments. It is said to have high tinting power and may be used to produce a wide range of shades in all depths of color. The new pigment is available in the form of toners, lakes, dispersed powders, water dispersions, pastes, and presscakes.

Phthalocyanine pigments are an important factor in the color industry, and have long been noted for their excellent lightfastness, heat stability, and resistance to degradation by acids and alkalis. For years they have provided exceptionally bright and clean colors in the blue to blue-green range. Until now, however, there has been no significant expansion of their color spectrum since phthalocyanines were commercially introduced in the late 1930's.

**Robert Hamilton, advertising mgr, General Aniline & Film Corp's Dyestuffs & Chemical Div, shows display on new yellow-green phthalocyanine pigment to Robert Brouillard, mgr, GAF's Pigment Dept. The display, in keeping with St Patrick's Day, shows test samples of textile yarns, textile prints, plastics and paint panels where the new Heliogen Viridine Y was used.**

**Robert Brouillard admires the green stripe painted on New York's Fifth Avenue for the annual St Patrick's day parade. Heliogen Viridine Y was used to provide the vivid green color.**

---

## Solutol-S

The optimum in softness and smoothness is the result claimed for Solutol-S, a new finishing agent announced by Soluol Chemical Co, Natick, RI.

Designated for resin finishing of cottons and synthetics, particularly in connection with thermosetting resins for crease-resistant fabrics, Solutol-S is said to be effective in yielding increased tear strength, tensile strength and crease angle values as well as excellent sewability and abrasion resistance. It is reported to be nonyellowing and nonchlorine-retentive.

Solutol-S is also said to be effective as a pure finish or used with other agents, such as thermoplastic resins, starches, gums, etc.

---

## Lanasyn Olive 2GL paf

Lanasyn Olive 2GL paf, a new homogeneous 2:1 metal complex dye, has been added to the Sandoz series of Lanasyn dyes for wool, nylon, and silk. It is said to be the fastest to light of the true olives. Because of its high solubility, it is especially recommended by Sandoz for package dyeing and vigoureaux printing. Its shade and list of properties may be seen in Sandoz publications available in the company's District offices.

---

## AEEA

The addition of aminoethylethanolamine (AEEA) in commercial quantities to its amine product line has been announced by the Dow Chemical Company.

Prepared by reacting ethylenediamine with ethylene oxide, the product has a number of commercial applications in the textile industry as an intermediate in detergents, wetting agents, emulsifying agents, dyeing assistants, softening and waterproofing agents.

## New Dextrinization Process

A new dextrinization process patented by the A E Staley Mfg Co promises cleaner, lighter-color, more uniform and specification-sure dextrins, Staley researchers report.

L S Roehm, vice president heading the company's corn division, said that dextrin produced by the new process represents a big step forward to meet specialized requirements of a number of industrial users.

The new process reportedly "fluidizes" dry powdered starch by air flow to permit an extremely even distribution of heat and acid to each particle of starch for conversion to dextrin.

The conversion is much more uniform than with conventional batch dextrinization, according to Ralph E C Fredrickson, Staley's director of engineering research and inventor of the new process.

Better control of the starch-to-dextrin conversion in the new process reportedly makes for more uniform dextrins, produced to exacting specifications over the wide range of dextrin requirements. The new dextrins also tend to be lighter in color and are cleaner, it is claimed, because the process is free of localized acidity concentrations, which cometimes cause the starch to char in conventional conversion methods.

James P Casey, director of Staley's technical service, said the new development will be of particular interest in industries where dextrin cleanness, light color, uniformity and specification requirements are important. Principal applications in the textile industry will be for print thickening, finishing and dyeing.

The process is covered by US Patent 2,845,368, issued recently to Dr Fredrickson and assigned to Staley's.

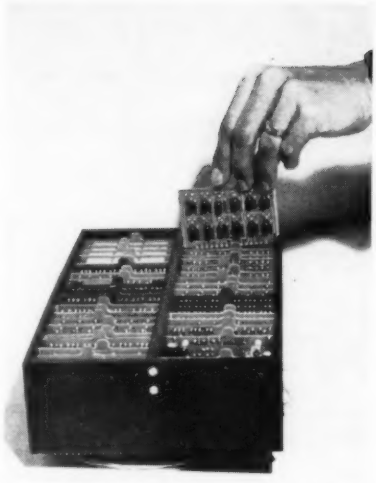
---

## Analog-to-Digital Converter

A new airborne, electronic system that weighs only seven pounds and is slightly larger than a milk bottle, has implications for industrial process controls, automation, etc where instantaneous accurate information is required.

Known as the Multi-Channel Analog-to-Digital Converter, Model CG 591, the new system, which is believed to be the smallest completely solid state airborne converter, was developed by C G Electronics Corp, Albuquerque, NM, a subsidiary of Gulton Industries, Inc, Metuchen, NJ.

According to Harold Poulsen, general manager, C G Electronics Corp, "the completely transistorized converter possesses numerous advantages over present systems in that it contains an automatic error checking system and digital readout, and that no function is sacrificed in spite of the system's low power requirements.



**Multi-Channel Analog-to-Digital Converter, Model CG 591**

Utilizing the PCM method of operation, the new system reportedly attains accuracies of 0.2% and can be made compatible with any computer code because of its building block construction, which uses modular techniques.

"Featuring built-in transient surge protection, the converter is adaptable to on-line entry into digital computers which not only saves valuable time, but eliminates errors encountered in the reduction of information," Poulsen said.

Other outstanding features of the new system, the speaker said, are: high accuracy, extreme reliability, low power consumption, small size and weight and modular construction, which provides a high order of system flexibility.

Because of the modular construction, a relatively small number of subsystems can be combined to form many systems depending upon application. In effect, custom systems may be formed from standard subsystems.

Various combinations of circuits, such as flip-flops, mono- or bistable multivibrators, AND, OR, and NOT gates, and emitter followers, comprise the desired subsystems. Subsystems of decade counters, ring counters, command units, parity checkers and the like, constitute the complete analog-to-digital converter.

Normally designed to receive 12 inputs, 50 or more can be scanned depending upon the scan rate required," Poulsen explained.

## 30-lb Industrial Pail of Eastonair

Easton R S Corp, Brooklyn, NY, has introduced a new 30-pound industrial pail unit of its Eastonair product, which has been used for the last three years in the professional air-conditioning field to control free formaldehyde fumes liberated from resinated fabrics and garments.

The manufacturer states that the introduction of this new industrial unit will enable a more economical treatment of larger areas possessing free formaldehyde fumes. Until recently, installations of all sizes have have been handled with the one-, five- and ten-pound units; however Easton was requested to develop an industrial unit that could be used to handle larger installations, such as dress storage areas, fabric warehouses, converter areas, cutting and sewing plants, hook-off areas as well as fume trouble spots in finishing mills.

Introduction of the 30-pound unit, which in surface area and total reactive surface of product, reportedly allows one compact unit to treat approximately the same area as eight No. 500 (five-lb unit) standard packages. The recommended treatment of formaldehyde fumes is 3.5 lbs of Eastonair per ton horsepower of air conditioning. Under static installations, or where there is no forced air flow to move the formaldehyde-laden air, it is recommended that five No. 500 units be installed for each 2,000 square feet of floor area. It is claimed that the latter installation will not require replacement for three or four months; however, it is also claimed that one 30-lb industrial pail will treat that same area for over six months without replacement.

Eastonair is activated by removing the lid and placing the open unit(s) within air ducts (return or supply), plenum chambers, registers, etc. Under static conditions the open units are placed on shelves, special ledges, storage racks, under tables along aisles or hung from overhead pipes or rafters. Eastonair is said to be extremely effective when installed in air conditioning nearest the refrigerant coils where the air is cooled. The desire is to place the product in a stream of air, possessing fumes, where maximum air contact is achieved. The further away from a forced air system, the more difficult it is to achieve a satisfactory or economical control of fumes.

Eastonair is priced at $14.50 per five-lb unit, packed eight units per case. The new industrial pail (net 30 lbs) is priced at $2.50 per lb, where discounts are allowed on volume orders.

# • NAMES IN THE NEWS •

Gill

Arnold, Hoffman & Co, Inc has named **C Russell Gill** sales consultant on textile chemical auxiliaries for sizing and finishing.

Mr Gill has been employed by Holliston Mills of Tennessee and Stein, Hall & Co, and for the past 20 years by Southern Sizing Co, of which firm he was president from 1946 until his recent resignation.

He will operate from the Atlanta and Charlotte Sales Offices of Arnold, Hoffman. In addition to his capacity as sales consultant, Mr Gill will assist in new product development in the above fields.

---

Appointment of **Larry Hallett** as manager of the Technical Sales and Customer Service Department of Jefferies Processors, Inc, and The Tow Dyeing Corp has been announced.

Mr Hallett, who until a short time ago was with DuPont Company's Technical Service Department, Textile Fibers Division, has a wide background of experience in knitting, finishing and dyeing processes for nylon, Dacron and Orlon.

---

**Leland A Underkofler,** director of research at **Tankamine Laboratory,** Division of **Miles Laboratories, Inc, Clifton, NJ,** has joined the AATCC Committee on Evaluation of Enzyme Agents.

Dr. Underkofler is co-author with Richard Hicky of the two-volume publication "Industrial Fermentation" (Chemical Publishing Co).

---

**H Bunde** of Farbwerke Hoechst AG, Frankfurt-Hoechst, West Germany, recently arrived in New York to take over his duties as a technical and scientific representative in the United States for Farbwerke Hoechst AG, as well as to assume the position of vice president of The Uhde Corp of New York. Dr Bunde, in these capacities, is the successor to **Hans Hoyer,** who is returning to the home office of Farbwerke Hoechst AG in Frankfurt-Hoechst.

Hoelscher

**James W Hoelscher** has been appointed manager of market research for the Wallerstein Co, New York, NY.

Previous to joining Wallerstein, Mr Hoelscher was affiliated with the Ohio Oil Co between 1948 and 1951, and with the Freeport Sulphur Co from 1953 to 1958.

---

**Martin J Lydon,** president of Lowell Technological Institute, Lowell, Mass, was honored on February 28 as Lowell's "Citizen of the Year" by the Greater-Lowell Civic Committee.

Speaking at a special banquet honoring Dr Lydon was **Kenneth R Fox,** vice president, Fabric Research Laboratories, Inc, Dedham, Mass, and Dr Lydon's immediate predecessor as president of LTI.

Describing the honored guest as "one of the real leaders in engineering education," Dr Fox noted some of the changes at Lowell Tech since Dr Lydon became president in 1950. "The curriculum now includes engineering departments in plastics and electronics as well as textiles, leather, and paper," Dr Fox stated, "and Dr Lydon's efforts in behalf of a nuclear reactor for the school show that he is far from being satisfied with the status quo."

The speaker took note of the new buildings on the campus and the fact that Lowell's student body had almost doubled during Dr. Lyon's nine years as president. Dr Fox stated also that he was pleased to be able to say that the social sciences and humanities were recognized at LTI as an integral part of an engineering education and that "all of us interested in education and active in industry know how important this is."

"Few educators are as active as Dr Lydon in public appearances to enhance the reputation of their own schools and advance their own philosophies of engineering education, and this effort of Dr Lydon on behalf of LTI should not be underestimated," Dr Fox concluded.

Miller

**Richard E Miller** has been appointed district sales manager in charge of dye sales in the northeastern states for Eastman Chemical Products, Inc, subsidiary of Eastman Kodak Company. Headquartered in the company's Lodi, NJ, distribution center, Mr Miller will also direct the work of the service laboratory there.

Mr Miller joined the Eastman organization in 1936 working in the dye research laboratories at Eastman Kodak Company in Rochester, NY until 1941 at which time he entered the armed service. Returning in 1945, Miller joined Eastman's dye sales group and has remained in northeastern area since that time.

---

The promotion of **Edward A Dalmas** to assistant manager of the southern sales territory of Becco Chemical Division, Food Machinery and Chemical Corporation, Buffalo, NY, was recently announced.

Mr Dalmas joined Becco as a sales representative in 1956. Since that time he has served customers in the south, operating out of Valdese, NC. He will continue his work in this area and now will also become assistant to **D Stewart Quern,** Southern manager.

---

American Conditioning House, Inc, Boston, Mass, has announced that negotiations have been completed through which **Giles E Hopkins,** formerly technical director of the Bigelow Sanford Carpet Co, director of applied research for the Textile Research Institute, and research director of The Wool Bureau, Inc, will become associated with American Conditioning House as consultant.

Through this arrangement, Mr Hopkins' advice and council on wool and fiber technology, and on broad policies of marketing and textile production, will become available to American Conditioning House and, through that organization, to the wool marketing and textile industries.

L Aubrey Goodson Jr, formerly assistant director of research for Dan River Mills, Inc, has been named the company's director of research to succeed **Harley Y Jennings**, who retired on April 1. It is expected that Mr Goodson would be elected an officer of the corporation at the next meeting of the board of directors.

Currently Mr Goodson is a patent attorney with the firm of Fisher, Christen and Goodson in Washington, DC. He has handled Dan River's patent work for many years, both during his earlier employment by the company and in his association with his present law firm.

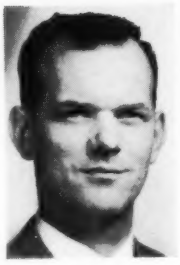
The retirement of Dr Jennings on April 1 marked the termination of an outstanding 16-year career with Dan River Mills, the last 10 years as head of the company's research division. During his tenure, special resin finishes developed in Dan River's laboratories, first the trademarked "Wrinkl-Shed", and later the wash-and-wear finish, "Wrinkl-Shed with Dri-Don", became household words. The excellent consumer acceptance of fabrics having these special finishes has been recognized as an important factor in Dan River's good sales record in recent years.

Dr Jennings is credited with many other developments which have resulted in better quality fabrics and manufacturing economies. The new research and chemical manufacturing plant which the company has announced will be constructed in the near future represents Dr Jennings' latest achievement. It will serve as a monument to his administration of Dan River's vital research and development program.

Graduated from Adrian College in Adrian, Mich, Dr Jennings received his master's degree and his doctorate from the Univ of Michigan. Formerly a professor of chemistry at both Kansas and Michigan universities, he was vice president of Copeman Laboratories in Flint, Mich, when he resigned to join Dan River in 1943. He was appointed director of research at Dan River in 1949.

Active in professional societies, Dr Jennings is currently a member of the American Association of Textile Chemists and Colorists, the American Chemical Society, the American Association for Advancement of Science, the American Association of Textile Technologists, and the Textile Institute.

Following his retirement, Dr and Mrs Jennings plan to spend several months in California and Michigan visiting their sons and grandchildren. Next on their schedule is a three-month tour of Europe.



**Savage**

**Overberger**

Organization changes significant to the operations of the Chemical Division of The Goodyear Tire & Rubber Company have been announced.

Involved in the new alignment are **R S Savage, W F Overberger,** and **John Platner.**

Savage has been assigned as senior sales engineer in the Coatings department where his responsibilities will include sales service work pertaining to sales of latices to the textile, paint, and paper industries.

Overberger has been transferred to the Chemical Division's development department. In this post, he will be responsible for liaison on technical developments involving Plioflex synthetic rubbers produced at Goodyear's Houston, Texas plant.

Platner joins the Rubber and Rubber Chemicals department as a senior sales engineer.

---

**Smaltz**

**Shattuck**

**John C Smaltz** has resigned as president of McKierñan-Terry-Corp, Dover, NJ, to devote his entire time to the engineering and research work of the corporation as its consulting engineer.

**Carl W Shattuck,** formerly first vice president, succeeds Mr Smaltz as president, and **Frank Hamilton,** formerly works manager of the Dover plant, has been named vice president.

McKiernan-Terry, which manufactures a line of open-frame convertible calenders and other textile wet-processing equipment, acquired the Textile Machinery Division of the Weisner-Rapp Corp, Buffalo, NY, in 1956.

**A Bingham Owens,** manager of the Atlanta, Ga district office of DuPont's Dyes and Chemicals Division, retired March 1 after 37 years with the company.

At the same time, the Atlanta and Charlotte offices of the division were consolidated into a new Southern district sales office located in Charlotte, with **Robert D Sloan** as district manager. Mr Sloan, who has been manager of the Charlotte district since 1946, will be assisted by **W Fred Crayton** and **Hyman H Field** as assistant managers of the Atlanta and Charlotte offices, respectively.

Mr Owens, a native of Oxford, NC, and a graduate of the University of North Carolina from which he obtained his bachelor of science degree in chemical engineering in 1921, has spent his entire career with the dyestuffs sales division of the DuPont Company, including 10 years as an export sales representative in the Orient.

He joined the DuPont Company in 1921 as a laboratory assistant in the Charlotte district office, became a dyestuffs salesman shortly afterwards, and in 1925 was assigned to the company's Shanghai sales office. The following year he was sent to Tientsin, China, as the first manager of DuPont's dyestuff sales office there, a position he held until 1935 when he was transferred to the export sales section in the company's home office in Wilmington, Del.

After eight years as assistant export sales manager of the Dyes and Chemicals Division, Mr Owens was named sales promotion manager of the division in 1944. Late in 1946, he was appointed Atlanta district manager.

**J A Turner,** manager of the Chicago district office of Du Pont's Dyes and Chemicals Division, completed his 40 years with the company in February, while **C Harrell Asbury,** sales manager of the division's dyes section, rounded out 25 years.

---

**Edward L McCaffery,** assistant professor in the division of chemistry at Lowell Technological Institute, has been awarded a one-year contract for sponsored research on a project related to polymer chemistry by the LTI Research Foundation.

The research grant will supplement Dr McCaffery's teaching duties at the Institute. By means of sponsoring research projects by faculty members, the Foundation will contribute to the advancement of instructional and research programs within the Institute and to the enhancement of the professional status of the faculty.

# ABSTRACTS

## Some Chemical Foundations of Fast Color Printing

Alsberg, F R, Clarke, W, and Fern, A S, *J Soc Dyers Col* 75, 89-101, Feb, 1959

The chemical foundations of the printing of cotton fabrics are discussed. In this paper only vat, "onium" (Alcian) and reactive (Procion) dyes are considered; these three groups represent distinct stages in modern printing technology.

A table is included showing the interrelations of various factors affecting vat dye printing. The "leuco potential," which is an inherent property of every vat dye, indicates its relative ease of reduction under printing conditions. Dyes with a high leuco potential are usually difficult to print, especially if they are also slow to reduce

In vat printing, only a limited time is available for the dye to be reduced and absorbed, and a rapid rate of reduction is desirable. The rate can be increased by the presence of reduction catalysts, and to a lesser extent by altering the physical form of the dye.

The authors stress the importance of using a sufficient quantity of reducing agent to reduce any vat dye printed, and to maintain it in the reduced condition until it has been fixed; also the necessity of avoiding premature loss of reducing agent before or during steaming.

Fixation of the "onium" dyes in printing is accomplished by converting the water-soluble form of the dye to an insoluble form during steaming, either by the addition of a volatile acid and an alkaline salt, or by the use of a nonvolatile acid and a solvent, followed by treatment with a dichromate and a hot alkaline wash.

Alcian dyes cannot be combined with anionic dyes (ordinary water-soluble dyes) or with anionic wetting agents and other printing auxiliaries.

Reactive (Procion) dyes depend for their fixation on condensation with the hydroxyl groups in the cellulose molecule. The chemistry of the reactive dyes is described. The print pastes contain urea, sodium bicarbonate and sodium acetate, the amounts varying with the different Procion brands. Fixation of the prints is accomplished by steaming, or in some cases by dry heat alone. The optimum treatment varies with the individual dyes.

Eleven references to the literature are cited.

## Some Experiments on the Effect of Dye, Fiber and Atmosphere on Lightfastness

Schwen, G and Schmidt, G, *J Soc Dyers Col* 75, 101-5, Feb, 1959

In the light of present knowledge, it is now quite clear that the system comprising dye and fiber together—or rather, dye, fiber and further components—is necessary to define the lightfastness of a particular dyeing.

The earliest observations on the variation of lightfastness of a dye on different fibers were made on Indigo, which is fast to light on wool (grade 7-8) but not so fast on cotton (grade 3). Furthermore, various workers in this field have found that a dyeing fades under the influence of light only where water and oxygen are present, either in the fiber or in the atmosphere surrounding the fiber.

The present paper gives the results of a series of experiments designed to explain further the interrelations between the various factors involved. The difference in fastness to daylight of eight selected basic dyes on different fibers in various atmospheres has been examined.

The dyeings were exposed in glass tubes filled with the following gases: 1) dry oxygen, 2) moist oxygen, 3) dry nitrogen, 4) moist nitrogen, 5) control exposed in an open tube to normal atmosphere but under similar conditions.

The dyes tested were Basic Blues 3, 16, 18 and 26, Basic Orange 22, Astra Violet FN Extra, and Diazacyanine Blue and Yellow. The dyeings were exposed to daylight at Ludwigshafen, Germany.

Tables are included showing the amount of fading of these various dyes on cotton (mordanted with Katanol O), viscose rayon, cellulose acetate, silk, wool, and Orlon 42, all rated on a 1 to 8 basis.

The values obtained from these exposures show two broad effects:

1) The lightfastness of the dyeings of some basic dyes on various fibers depends to a large extent on the amount of oxygen present in the surrounding atmosphere.

2) As anticipated the lightfastness of the dyeings depends on the quantity of moisture in the tubes.

The surprising fact is that exposure at a given humidity in nearly pure oxygen does not necessarily give the lower lightfastness figure that one would tend to expect. In several cases the results obtained in the tubes containing nitrogen are worse than those obtained in oxygen.

The authors give a "cautious interpretation" of the results obtained. They conclude that under the conditions of the tests the diazacyanine dyes were reduced in the fading process and the other dyes were probably oxidized. It appears that the first step towards oxidation or reduction causing the fading of a dyeing possibly depends on the ability of the dye to act as an acceptor. It is pointed out that in daylight and in the presence of certain acceptors, water can have both a reducing and at the same time an oxidizing effect.

Eleven references to the literature are cited.

EMKAY CHEMICALS FOR YOUR TEXTILE PROCESSING
EMKAY MANUFACTURES:
• Emkabase • Emkalube • Emkasize • Rexol... • Re...
• Emkacide • Emk...net • Em...
• Emkafol
• Emkagen
• Emkalane
• Emkalite
• Emkalon • Emkawate • Rexogum • Rexoscour
• Rexosolve • Rexowax
• Rexoslip • Rexowet
DYEING DACRON® ARNEL® KODEL®!
NEW TECHNICAL BROCHURE AVAILABLE
WRITE FOR YOUR COPY TODAY
• Rexogel • Rexopon
EMKAY
MANUFACTURING CHEMISTS
EMKAY CHEMICAL COMPANY
EMKA PRODUCTS · REXO
EMKAY CHEMICAL COMPANY
319-25 Second St., Elizabeth, N. J. ELizabeth 2-7053 - 7695

trogen, 5)
en tube to
nder simi-

asic Blues
Orange 22,
nd Diaza-
he dyeings
Ludwigs-

owing the
se various
nted with
, cellulose
lon 42, all

rom these
d effects:
ne dyeings
ious fibers
nt on the
nt in the

ghtfastness
the quan-
es.
t exposure
early pure
y give the
that one
n several
d in the
are worse
ygen.
utious in-
obtained.
the con-
azacyanine
he fading
lyes were
rs that the
on or re-
of a dye-
he ability
cceptor. It
ylight and
acceptors,
ucing and
ing effect.
literature